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PROGRESS REPORT ON RESEARCH AND RELATED SERVICE
APPLICABLE TO
→ DECIDUOUS FRUITS AND TREE NUTS

Including Work in United States Department of Agriculture
and Certain State Work Financed in Part with
Agricultural Marketing Act Funds

Prepared for Use in Connection with the
January 1955 Meeting of the
Deciduous Fruit and Tree Nut Research and Marketing Advisory Committee

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This progress report is a "tool" for: (1) administrative use in
program development, coordination and evaluation; (2) advisory
committee use in formulation of recommendations in regard to present
and future programs. The material in the report is not for publi-
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Abbreviations of Agency Names

USDA agencies responsible for conducting or supervising the work covered in this report are indicated by initials as follows:

AE	Agricultural Engineering Research Branch	(ARS)
AEC	Agricultural Economics Division	(AMS)
AES	Agricultural Estimates Division	(AMS)
APH	Animal and Poultry Husbandry Research Branch	(ARS)
BS	Biological Sciences Branch	(AMS)
ENT	Entomological Research Branch	(ARS)
EU	Eastern Utilization Research Branch	(ARS)
FAS	Foreign Agricultural Service (Independent)	
FCS	Farmers Cooperative Service (Independent)	
FES	Federal Extension Service (Independent)	
FS	Forest Service (Independent)	
FV	Fruit and Vegetable Division	(AMS)
HC	Horticultural Crops Branch	(ARS)
HE	Home Economics Branch	(ARS)
HN	Human Nutrition Branch	(ARS)
MRD	Market Research Division	(AMS)
OES	Office of Experiment Stations	(ARS)
PE	Production Economics Research Branch	(ARS)
PPE	Plant Pest Control Branch	(ARS)
PQ	Plant Quarantine	(ARS)
SDA	Liaison Office, Commissioners of Agriculture	(AMS)
SU	Southern Utilization Research Branch	(ARS)
SWC	Soil & Water Conservation Research Branch	(ARS)
WU	Western Utilization Research Branch	(ARS)

COOPERATION

Much of the research on deciduous fruits and tree nuts covered in this report, particularly that relating to production is conducted cooperatively by the USDA bureaus and the State agricultural experiment stations. This cooperative effort usually begins with the inception of the need for a job from farmer and industry contacts and extends by joint planning of work programs, cooperation in doing the research job, and, finally, making available the results on the joint effort. The detailed arrangements for the cooperative work vary considerably, depending upon the available facilities, financial support, and personnel and the State policies involved. In principal, the cooperative efforts by the USDA and the State Stations are planned so as to utilize to the best advantage the personnel and facilities of both agencies and to assure coordination of effort. In most of the reports which follow, the detail required to explain specific cooperative relationship is omitted.

Most marketing service and educational work covered in this report also involve varying degrees of cooperation between the USDA, State Departments of Agriculture and Bureaus of Markets, State Extension Service and industry groups.

FUNCTIONS OF ADVISORY COMMITTEES

The Deciduous Fruit and Tree Nut Research and Marketing Advisory Committee is one of a number of committees authorized by Congress in 1946 to advise the Department of Agriculture with respect to specific research and service programs.

The committees have been asked to consider all of the research and marketing service work of the Department in their respective fields. This is in recognition of the value the Department places upon the advice and counsel received and is in accord with suggestions of Congressional committee members who are directly concerned with the work.

These committees are performing an important function, in advising with respect to the development of the Department's research and marketing service programs. However, it is recognized by members of Congress, committee members, and the Department that the implementing and administering of those programs are the responsibility of the Department.

The functions of the advisory committeemen include:

1. Acquainting themselves with the problems of producers, all segments of the industry and of other groups, and presenting them for committee consideration.
 2. Reviewing and evaluating the current research and marketing service programs of the Department, including work under way at Federal laboratories and field stations.
 3. Recommending adjustments in the Department's program, including priorities for new work and expansion of work under way.
 4. Developing a better understanding of the nature and value of the agricultural research program, explaining it to interested persons, groups and organizations and encouraging the wider and more rapid application of the findings of research.
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I PRODUCTION RESEARCH

A. Progress on Work Under Way

INTRODUCTION, BREEDING, AND VARIETY EVALUATION

INTRODUCTIONS OF FRUITS AND TREE NUTS - HC

Progress and Findings - During the past year a total of 559 fruit and nut introductions were received from foreign sources. These consisted of 16 apple, 45 pear, 41 grape, 73 citrus, 270 cherries, 46 peach, 9 plum, 14 almond and 23 apricot varieties. In addition 14 small fruit and 8 miscellaneous. All fruit and nut introductions received as scions or trees are usually grown in quarantine for two growing seasons to determine the presence or absence of insects and diseases before their release. Seed introductions are distributed soon after received.

At the United States Plant Introduction Garden, Chico, California, several hundred persian walnut seedlings representing introductions from a number of foreign countries have been under evaluation for a number of years. One of these resulting from seed introduced from Poland in 1937 blooms late enough to escape spring frosts, is quite fruitful and matures its nuts relatively early. It may prove of value as a direct introduction but its greatest promise is in its usefulness as a parent in breeding better walnut varieties.

APPLE AND PEAR BREEDING AND VARIETY EVALUATION - HC

Progress and Findings - At Wenatchee, Wash., 9 new strains or sports of Red Delicious have been budded in a test planting. These strains have been propagated on a dwarf stock (Malling No. VII) in order to hasten fruiting. It appears evident that some of these sports will replace the present Red strains of the Delicious variety. Sports of Winesaps and other varieties are also being collected for testing.

It has been observed that many sports and strains originate from adventitious buds. An effort has been made to induce sports by "heading back cuts" that will force adventitious buds. A total of 60 trees were so pruned in 1954.

At Beltsville, 62 selections of fire blight resistant pears have been made of trees that produce good to excellent quality fruit. Three new selections were rated very good to excellent and 4 more were rated good to very good in 1954. Fifty-five of the selections have been propagated for second tests. All selections have shown blight resistance, even though inoculated 4 seasons with the organism. During the 1954 season 260 fruit samples were evaluated.

At Medford, Oreg., a destructive freeze destroyed all crosses made in 1954, and also eliminated the crop on all hybrids.

Plans - Cooperative work has been initiated with the Indiana Agricultural Experiment Station to develop apple breeding material highly resistant or immune to scab. Other breeding work will continue at present level and substantially as now under way.

Publications

None.

STONE FRUIT BREEDING AND VARIETY EVALUATION - HC

Progress and Findings - 1954 recommendation. Expand breeding for nematode-resistant peach stocks. (14/16)* Within the overall peach breeding program, greater emphasis is being given to breeding for nematode-resistant, hardy stocks.

Peach breeding programs for Central and Eastern United States were continued at Beltsville, Maryland, and Fort Valley, Georgia. Objectives are still to develop superior varieties with a succession of ripening dates which are resistant to bacterial spot and other diseases. At the Georgia Station early ripening varieties which may be shipped long distances and which are fruitful after relatively little winter cold are additional important objectives. At Beltsville, varieties which are resistant to low winter temperatures and which ripen during mid-season and also late ripening varieties are specific objectives. In Western United States stone fruit breeding is conducted at Fresno, California, and Prosser, Washington (in cooperation, Wash. Exp. Station). Early freestone varieties for irrigated western conditions is the principal objective at Fresno, whereas apricot and sweet cherry improvement as well as the development of early freestone peaches are specific objectives in the Northwest.

* (14/16) Means fourteenth in priority of sixteen recommendations of 1954 in Production Research.

Two new peach varieties were introduced this past season. The Redglobe, developed at Beltsville, ripens with Burbank July Elberta or about 15 days ahead of the regular Elberta. The skin color is especially bright and attractive. The flesh is yellow, relatively free of red at the pit, very firm, fine textured, and of good flavor. This variety should be well suited to long distance shipping. The Keystone, bred at Fort Valley, Georgia, requires very little cold and should be most valuable in southern areas where the lack of sufficient cold sometimes prevents normal production of such varieties as Elberta. It ripens slightly ahead of Triogem; about 3-1/2 weeks ahead of Elberta. It is round with light pubescence and an attractive red blush over a bright golden ground color. The flesh is firm, yellow and of good flavor. The pit is very nearly free.

Breeding work for resistance to nematodes is being continued both at Beltsville and at Fort Valley in an effort to develop a satisfactory rootstock for areas in which nematodes are serious. Seedlings of the best selections are to be tested this winter under controlled greenhouse conditions. Several of the more promising selections are being propagated for distribution to some experiment stations for further detailed studies, especially for growth and production of orchard trees on these stocks.

In cooperation with the California Agricultural Experiment Station, 5 new plum varieties, resulting from the breeding work, are being introduced. Seven peach selections from the work at Fresno, California, showing definite superiority to existing varieties are being placed under trial with commercial growers. About 200 stone fruit varieties are being evaluated at Fresno for commercial value or use in breeding. Seedlings from various sources are being tested for nematode resistance and suitability as stocks.

At Prosser, Washington, work is continuing on the evaluation of peach varieties for canning (in cooperation with Utilization Branch). Several peach selections and 3 apricot selections from the breeding work are also being given wide tests.

Nearly 1,000 sweet cherry hybrids bore a first crop of fruit at Prosser in 1954. Fruiting was hastened by ringing some branches. On the basis of this first fruit, a number of seedlings appear outstanding as compared to the best commercial varieties. The best of these are being propagated for second test.

The stone fruit breeding work will be continued, substantially as at present.

Proposal for Committee Consideration - see page 11.

Publications

Dermen, Haig. Histogenetic factors in color and fuzzless sports of peach. Jour. of Hered. (In press)

Fogle, H. W. Peach and apricot varieties for the Northwest. Proc. 49th Ann. Mtg. Wash. State Hort. Assoc., p.p.132-136. Dec. 1953, and Western Fruit Grower.

Van, good pollinizer for Bings, Lamberts. Better Fruit Magazine, pp. 29-30. Feb. 1954.

A sweet cherry germination study. Proc. Amer. Soc. Hort. Sci. (in press). 1954.

Plums in the Northwest. Fruit Varieties & Hort. Digest (in press). 1954.

Havis, A. L. Peach varieties for Virginia. Va. State Hort. Soc., Jan. 26, 1954, Proc. 42(2): 97-100. Pub. Feb. 1954.

Releasal notice for Redglobe peach. Mimeo. May 11, 1954. Thompson, L. A. An evaluation of peach varieties growing at the U. S. D. A. Experimental Station, Fresno, Calif. Publ. and presented Proc. Nat'l Peach Council p.p83-84. 1954.

Weinberger, J. H. New peach varieties for the Southeast. Coast Line Agric. and Livestock Topics. 1954.

Releasal notice of Keystone peach. Mimeo. June 1954.

GRAPE BREEDING - HC

Progress and Findings - 1954 Recommendation, "Expand berry and grape breeding to permit larger populations for more rapid progress." (5/16) With present funds it has been impossible to increase grape seedling populations.

Grape breeding is carried on with American bunch grapes at Beltsville Md., and Meridian, Miss., with the muscadine grapes at Raleigh, N. C. (in cooperation with the North Carolina Agricultural Experiment Station) and Meridian, Miss., and with vinifera grapes at Fresno, Cal.

In the muscadine breeding work many perfect-flowered selections have been made and are being propagated for wide testing. Two of these have been sent to nurseries for propagation. The best of these hermaphrodites are undoubtedly of better quality than the pistillate varieties heretofore grown. Tests of productivity are being set up. For testing and breeding there are 64 tetraploid vines resulting from colchicine treatment of 16 muscadine varieties and selections, now growing at Raleigh, N. C.

In the bunch grape breeding work at Beltsville, several selections are sufficiently promising for wide testing.

At Fresno, Cal., the late seedless grape mentioned last year, of the Thompsons Seedless type, still seems very promising as a storage variety to extend the seedless grape season and is being given wider tests. Records are being obtained on about 320 varieties introduced from other countries.

Additional tetraploid grapes have been produced at Beltsville, and are being used in breeding in the expectation of obtaining larger size and possibly in obtaining fertile crosses of bunch and muscadine varieties.

Plans - The breeding work will be continued on the same level as at present. Attempts will be made to test small seedlings for black-rot resistance at Beltsville, thus greatly increasing populations that can be evaluated. Increased use of tetraploids will be made as the vines of those available mature.

Publications

Dermen, H. Man-made polyploids. Agric. Res. 4 pp. Oct. 1953.

Colchiploidy in grapes. Jour. Hered. 45: 159-172, 1954.

Loomis, N. H., C. F. Williams, and M. M. Murphy. Further studies on the inheritance of flower type in muscadine grapes. Proc. Amer. Soc. Hort. Sci. (in press). 1954.

Scott, D. H., and E. G. Christ. Releasal notice of Dix grape. Multilith. 1954.

Williams, C. F. Breeding perfect-flowered muscadine grapes. Proc. Amer. Soc. Hort. Sci. (in press). 1954.

BERRY BREEDING - HC

Progress and Findings - 1954 Recommendation, "Expand berry and grape breeding to permit larger populations for more rapid progress." (5/16)

Resources available did not permit the carrying out of this recommendation.

Cranberry breeding. About 1.6 acres of cranberry seedlings and selections are being grown at Wisconsin Rapids, Wisc., and the best ones will be determined during the next 2 years. In cooperation with the New Jersey and Massachusetts Stations, continued tests are being made of the value of 130 older selections. In New Jersey, leafhopper tests indicate that the leafhopper (the vector of cranberry stunt) does not survive on one native tetraploid cranberry from Washington State. This cranberry may be valuable for breeding for resistance to the insect and the false blossom virus.

Blueberry breeding. Cooperation is being continued on an extensive scale with the Georgia Coastal Plain, the North Carolina, and the New Jersey Experiment Stations and with 4 growers in New Jersey, Massachusetts, Connecticut, and Michigan who themselves bear the cost of raising seedlings. Similar cooperation has now been started with the Maine and Florida Experiment Stations; at the Maine Station for very hardy kinds and at the Florida Station for low-chilling-requirement early varieties. Extensive tests are under way to determine if resistance to the diseases stem canker and mummy berry can be detected in young seedlings before field planting. One new selection, 18-96, of the Rancocas season has been furnished propagators for increase and introduction in the winter of 1955-1956.

Strawberry breeding is conducted at Beltsville and in cooperation with State Experiment Stations at Salisbury, Md., Raleigh and Willard, N. C. and Corvallis, Oreg. One new variety, Stelemaster, resistant to all known strains of red stele in the East, was released during the year and a second variety (Oreg.-US-2172), resistant to this disease in Oregon and Washington is being propagated for release in the Northwest. Many other red stele-resistant selections are being given wide testing. In red stele-disease tests to eliminate susceptible seedlings when small 33,500 seedlings were planted in red stele-infested soil in Maryland and in Oregon in 1953 and 4,300 seedlings saved as resistant were planted in the fields in 1954 for fruiting. About 25,000 seedlings in Maryland and 20,000 in Oregon are in the benches for similar tests - this winter. Two exceptionally hardy everbearing varieties, Arapahoe

and Radiance, were released in 1954 from the U. S. Station at Cheyenne, Wyoming. Both varieties inherit extreme winter hardiness from F. ovalis, the native western strawberry. Arapahoe has exceptionally high flavor under Maryland conditions.

At Beltsville, Md., a replicated test of 20 strawberry varieties, using virus- and nematode-free stock, is under way.

Blackberry breeding is being continued at Beltsville and in North Carolina and Oregon, with several selections being propagated for wider trial. In North Carolina one dewberry selection is being tested extensively and appears superior to Lucretia and Carolina. In Oregon there are a number of different types of blackberries under test. Many seem superior to varieties introduced in the past because of larger size, greater yield, and high flavor comparable to Cascade. Five promising selections are being widely tested and 6 new selections were made in 1954. At Beltsville, the objective is origination of thornless varieties adapted to Eastern United States. Nine hundred thornless seedlings in the field that were large enough to fruit in 1954 were evaluated for hardiness following severe winter injury in January and February, 1954. Twenty-seven thornless seedlings have been selected for further testing and are being propagated. Two of these show promise as commercial types and will be given a regional test. About 37,000 seeds were saved in 1954 from crosses and open pollination of the thornless selections.

Raspberry breeding. Work is in progress at Raleigh, N. C. and Corvallis, Oreg., on about the same scale as last year. In North Carolina, Asiatic species have been used as parents for disease resistance and heat tolerance. Selections that are 3 to 4 generations removed from the original Asiatic parents are approaching American types in fruit quality. Some of these selections are being tested in southern regions. The Oregon work continues to be concentrated on origination of varieties adapted to West Coast growing conditions with high-quality fruit for frozen pack and canning. Sixteen new selections were made in 1954. All promising selections are screened for frozen pack quality. Three selections are being tested extensively for possible introduction. All promising selections have been planted on a heavy clay loam soil to test for adaptation to wet soil since plants of some varieties are superior to others in survival under such unfavorable conditions.

Plans - In cranberry breeding selection of desirable seedlings in Wisconsin, continuation of tests of species and of hybrids for resistance to feeding of the leafhopper vector of false blossom in New Jersey, continued evaluation of selections from former breeding in New Jersey, and additional tests of blueberry x cranberry crosses are to be made. In blueberry breeding, increased emphasis is being placed on making tests for quick elimination of seedlings susceptible to canker and mummy berry. Hybrids to incorporate drought and heat resistance, earliness, and low chilling requirements into southern blueberries will be tested in cooperation with the Georgia and Florida Agricultural Experiment Stations. In cooperation with the Maine Agricultural Experiment Station extreme hardiness will be incorporated into hybrids for northern conditions. In blackberry and raspberry breeding no major changes are planned but continued emphasis is on thornless blackberry breeding at Beltsville, on breeding blackberries for the frozen pack in North Carolina and Oregon, and on heat-tolerant raspberries in North Carolina. Red raspberry breeding in Oregon will continue to emphasize breeding for size, processing quality, and adaptability to heavy soils. In strawberry breeding no major changes are planned except for more emphasis in Oregon on continuous fruit production throughout the summer.

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TREE NUT BREEDING - HC

Progress and Findings - 1954 Recommendations, "Expand Chinese chestnut and almond breeding investigations." (15/16)

The work on almond and chestnut breeding was expanded insofar as funds and personnel permitted. This was done largely through a shift in emphasis on the work underway so as to permit more time of existing personnel to be devoted to the project.

Almond. In cooperation with the University of California, the testing and evaluation of trees developed under the cooperative almond breeding program was continued. The evaluation of chance seedling almond trees, bearing small nuts or unusually late blooming, is being made.

Breeding by hybridization of almond varieties for small nut characters, late bloom, and disease resistance has been stressed. Several thousand hybrid seeds produced in 1954 are to be planted next spring from these crosses. Peach x almond and apricot x almond crosses are being made in the hope of achieving self fruitfulness, late flowering, production of small nuts, and early ripening of the fruit.

Colchicine has been applied to buds and growing tips of Nonpareil almond trees to induce bud sports which might possess desirable characters. An instrument greatly facilitating the emasculation of stone fruit flowers has been devised.

Chestnuts. A crop failure at Beltsville on all chestnut seedling progenies in 1953 delayed the appraisal of this material. At Meridian, Miss., many of the seedlings resulting from cross- and open-pollinations fruited; of these 40 were selected for storage tests on the nuts. Two or three of these may have possibilities as new varieties for commercial plantings. In 1954, in tests involving more than 2,000 trees, it was found that although there were differences in uniformity between the progenies (open-pollinated) of different parents (female), the variability within a progeny was so great as to discourage the idea of being able to use a seedling progeny as planting stock in the establishment of a commercial orchard. Nevertheless, these seedling trees have made it possible to make a number of selections which are to be tested as possible new varieties.

Pecans. Pecan breeding work centered largely at Brownwood, Texas, was continued as before. In the crop year of 1953, there were 1,929 crossbred seedlings which produced their first crop. Out of this number, some showed excellent nut and growth characteristics. Scion wood of 18 selections has been distributed to growers for testing.

Emphasis in this breeding work is being placed on the creation of new disease-resistant varieties. In this work, the old varieties Stuart and Curtis that have shown outstanding scab resistance are being used as parents. In the spring of 1954, a total of 1,671 new crossbred seedlings were grafted on bearing trees to hasten their fruiting. In addition, 367 hican (pecan x hickory hybrids) seedlings were budded onto pecan stocks to hasten fruiting. These hicans are being studied to find if the resistance of the hickory to pecan scab and certain foliage diseases can be incorporated into new pecan varieties.

Filberts. A test orchard consisting of 9 varieties of filberts (each replicated 6 times in single tree plots) was planted in the spring of 1954 at Plant Industry Station. Eight of these new clones were selected during the past two years from F_2 hybrid seedlings grown largely from seed produced by the varieties Potomac and Reed. The ninth variety was the Potomac, included in the test for purposes of comparing its performance with the 8 selected clones.

Hybrid Walnuts. Less than 100 F_2 Eastern Black x Persian walnut seedlings were planted in the breeding plots due to a small nut crop 2 years before. A few of the oldest trees in the breeding plots bore nuts in 1954. A number of Persian walnut trees of the so-called Carpathian line have been observed in the Northeast in the past few years. Fifteen of these, appearing especially promising, were placed under test at Beltsville.

Plans - Insofar as funds permit, additional emphasis is to be placed on almond breeding, especially on the hybridization of the almond with other species of Prunus, such as the peach and apricot. Greater emphasis is to be placed on studies on the performance of seedling progenies of Chinese chestnuts resulting from seed produced under conditions of controlled pollination. Breeding work with pecan, hickory, hybrid walnuts, and filberts to be continued as in the past.

Publications

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- A. Proposal for Committee Consideration - Expand breeding work on stone fruit, strawberries, grapes, Chinese chestnuts and almonds, including the breeding for nematode-resistant peach stocks. No completely satisfactory nematode-resistant stocks are available for use on peaches in nematode-infested soil. Scientific personnel is available for handling an expanded breeding program on the above crops but more technicians, laborers and funds for growing larger populations to maturity are needed to make full use of the scientific personnel and available facilities. A modest increase in funds for this work would double the effectiveness of the programs.

Report on Conference with Private Fruit and Nut Breeders - The Deciduous Fruit and Nut Advisory Committee recommended in January, 1954, "that a conference of leading private breeders of fruit and nut trees, prominent growers of fruit and nut crops, and representatives of the Department and several State Agricultural Experiment Stations be held at an early date for discussion of the problem. The purpose of the conference would be to develop procedures for increasing the cooperation between private and institutional breeders in order to accelerate the breeding program with resultant benefits to both producers and consumers."

In response to the Committee suggestions, such a conference on a State-wide basis was held at Davis, Cal., August 27, 1954. Since private breeders are more active in California than in any of the other States and since both the California Agricultural Experiment Station and the U. S. Department of Agriculture have extensive fruit and nut programs in the State, it was felt that this was the best possible location for a regional meeting.

Most of the private breeders in California were present, as were the State and Federal workers engaged in breeding programs. In addition, about 50 fruit and nut growers were present and many participated in the discussion. Certain of the private breeders expressed the viewpoint that varieties developed by public agencies should in some way be sold to industry rather than being distributed gratis to propagators as at present. They pointed out the difficult competitive position of the private breeder who had to carry the cost of developing his material. No specific suggestions were made, however, as to how varieties developed at public expense could properly be sold to industry.

Individual growers present, who were not breeders, and representatives of the cooperative organizations dealing with fruit and nut crops were unanimous in their support of the breeding programs being conducted by public agencies. Some criticism was voiced of the private breeders

who patented and sold varieties with what was considered inadequate testing. The question was raised as to whether or not more extensive and adequate testing could be required. There appeared to be no legal way for the requiring of more extensive testing of such varieties prior to sale than is now being done. It was agreed that the grower is assuming a certain risk if he makes an extensive planting of a new variety, whether privately or publicly produced, without adequate preliminary trial.

Both State and Federal breeders present advised private breeders that they were most welcome to visit and inspect breeding plots and that if they desired certain parent material for use in their breeding work, it would be provided for them. It was emphasized by all present that private breeding effort is desirable and should be encouraged but not at the expense of curtailing publicly supported breeding programs.

Many questions were asked by growers and nurserymen relative to the working of the plant patent law, a matter of major interest.

Two members of the Deciduous Fruit and Tree Nut Research and Marketing Advisory Committee, Mr. Merrill and Mr. Birdseye, were present.

PESTS AND THEIR CONTROL

DISEASES AND NEMATODES - HC

Progress and Findings - 1954 Recommendation, "Expand research on antibiotics for the control of fruit diseases." (1/16)

An expanded field program included extensive tests of antibiotics for the control of fire blight of pears, bacterial spot of peaches, and Blight of Walnut. Results are discussed below. A laboratory is being established to study movement of antibiotics in plants, to screen available chemicals, and to do other basic work on systemic chemicals for disease control.

1954 Recommendation, "Expand greatly the research on virus diseases of fruits, including the establishment of national repositories of virus-free nursery stock (one on the West Coast and one in the East) and strengthen the regional research." (2/16) This has not been done in stone fruits because of limitation of available funds. Through re-orientation of personnel, some work has been initiated on virus diseases of grapes.

1954 Recommendation, "Expand studies on control of nematode injury to fruit and tree nut crops." (4/16)

Work has been expanded on nematodes affecting strawberry and raspberry, and on the screening of potential peach stocks for nematode resistance. See below for details.

1954 Recommendation, "Initiate research immediately on control of powdery mildew of apples, which has become an acute problem in some areas." (13/16) This has been done in part through reorientation of apple disease research. See below.

Apple and Pear Diseases

Control of fire blight with antibiotic materials - Extensive field experiments on the use of antibiotic materials on pears (streptomycin and a mixture of streptomycin and Terramycin) were conducted at Marysville, California and Hood River, Oregon. At Marysville, California, 720 Bartlett trees were treated. The effectiveness of 3 concentrations (100, 60 and 30 p.p.m.) of antibiotic material applied either 3 or 4 times at intervals of 14 days or 5 and 7 times at intervals of 7 days was compared with tribasic copper sulfate. The streptomycin-Terramycin mixture applied as a spray was highly effective in controlling pear blight without causing russet on the fruit. Excellent control was obtained at the lowest concentration (30 p.p.m.) indicating the commercial feasibility of using these expensive materials where the blight problem is acute.

At Hood River, using the very susceptible Forelle variety, three different commercial formulations of streptomycin were tested as well as the streptomycin-Terramycin mixture. All formulations, at 100 p.p.m., were highly effective.

A planting of 100 Bartlett pear trees were started early in 1954 at Plant Industry Station to determine if blight control can be achieved with antibiotic materials under the humid conditions prevailing along the Atlantic seaboard.

Small-scale tests in California and at Beltsville indicated that these materials, even at very high concentrations (500 p.p.m.) had no retarding effect upon the progress of the organism once it was established in the twigs. Measurements of the extent of twig involvement at the time the sprays were applied and at subsequent intervals showed that the organism continued to spread in twig tissues on sprayed trees at a rate equal to its spread in non-sprayed trees. The materials must be used in advance of infection to be effective.

An extensive experiment, using antibiotic materials for the control of blight on apples at Cornelia, Georgia, gave negative results due to absence of blight in the check plots. Experiments, using pear trees at Clemson, South Carolina, were likewise negative for the same reason. At Medford, Oregon, results were largely lost because a freeze destroyed the blossoms. It was found, however, that streptomycin sprays largely prevented blight when twigs were hand-inoculated.

Control of Mildew on Apples and Pears - In response to Committee action, work was initiated on powdery mildew control last season. The effectiveness of 10 materials was tested for the control of apple mildew on the variety Rome Beauty. The antibiotic material, Actidione, used at 1 and 2 p.p.m. did not retard the development of the fungus and did cause severe foliage injury. Wettable sulfur (6 pounds to 100 gallons) and Karathane, a commercial product, at the rate of 3/4 pounds to 100 gallons gave very encouraging results. Trees sprayed with either of these compounds at the pre-pink, pink, petal and first cover had much fewer mildew-infected leaves and less severe infection per leaf than any of the other treatments. At Hood River, Oregon, three materials were applied to pear trees for mildew control, but the experiment was inconclusive as very little disease developed in any of the plots.

Testing Resistance of Bearing Pear Trees to Blight Organism - Continuing the tests carried on for the past three years at Plant Industry Station, seedling pear trees of known parentage, bred for blight resistance, were again inoculated during the bloom period with a suspension of the pear blight organism and an abrasive material. In 1954, only 531 trees remained of the original stand of 1,873 trees and blight symptoms developed to some extent on 363 of these trees as the result of the inoculations.

Control of Bull's Eye and Other Storage Rots in the Northwest - Field experiments were continued at Hood River, Oregon, to test further the possibility of reducing storage losses by fungicidal treatments of the fruit while it is still on the trees. The results show clearly the interaction between rainy weather during the growing season and the prevalence of storage rots. Further experimentation is necessary before a definite control program can be formulated.

Control of Apple Scab - At Plant Industry Station the effectiveness of endomycin, an antibiotic material, was tested for the control of apple scab. At concentrations of 50 and 100 p.p.m., the material was ineffective on the susceptible Red Delicious variety. Other tests included a comparison of the effectiveness of mixtures of phenyl mercury and either glyodin or zineb, using both components of the mixture at 1/2 their normal concentration. Scab control was satisfactory, but the fruit sprayed with the mercury-glyodin mixture showed more russet than

the fruit given the mercury-zineb treatment. At Hood River, tests were continued with dinitro materials as eradicants when applied as ground sprays. Results obtained in 1954 indicated that the powder forms of these compounds were not as effective as the paste forms.

Pear Stony Pit Studies - Further observations at Plant Industry Station on the leaves of Forelle grafted in 1953 into suspected virus-infected trees revealed no signs of typical stony pit symptoms. This is the second growing season since the Forelle buds were inserted and the evidence indicates that the Plant Industry trees are not affected by the stony pit virus. No symptoms of stony pit were noted on seedlings grown from seeds taken from stony pit affected Bosc pears from Massachusetts and Oregon. Seedlings were also produced from seeds of Bartlett pears from disease-free trees and from trees top-worked on infected Bosc trees, from both diseased and disease-free Anjou fruit, and from commercial Forelle fruit (stony pit history unknown). After observations failed to show any suspicious symptoms on the various groups of seedlings, a representative number (50 or more) from each group had disease-free Forelle buds inserted. No stony pit symptoms developed on any of the Forelle leaves at the end of the fruit season. A small group of the trees have been planted outdoors for further observations. The results to date, however, fail to indicate seed transmission of the stony pit virus.

Plans - Work will be continued along the same lines as last year. Emphasis will be placed on (a) investigation of materials applied during the dormant season for apple mildew control; (b) further tests with new or improved formulations of antibiotics for pear blight control with special reference to eastern conditions; (c) further studies with antibiotics alleged to be anti-fungal in action for the control of pear and apple scab; and (d) further emphasis on the search for a rapid, accurate procedure for the diagnosis of stony pit.

- B. Proposal for Committee Consideration - Expand research on powdery mildew of apple. In recent years the use of sulfur in apple orchards has almost ceased and organic fungicides are generally used. These do not control mildew, but it is becoming a major disease with many varieties in eastern orchards. More effective control measures must be developed since we cannot go back to the sulfur control program which greatly injured the functioning of the trees. This problem merits major immediate attention.

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Stone Fruits

Control of Bacterial Spot with Antibiotic Materials - Continuing the work with Terramycin under way for the past two years, gelatin capsules containing known quantities of Terramycin, aureomycin, tetracycline or streptomycin were inserted in the trunks of peach trees in New Jersey. No results were secured as the capsules failed to dissolve and release the antibiotic materials. Subsequent small-scale tests showed definite translocation of the materials when the dry materials were inserted in holes and then water added. Other preliminary experiments gave positive indications of absorption and translocation when the materials were merely painted on the trunks of the trees, thus opening a new method of attacking this problem. The extreme sensitivity of the peach leaves to injury from spray materials necessitates development of methods other than foliage spraying for getting the antibiotic substances into the trees.

Peach Brown Rot - Extensive experiments in South Carolina to study the relationship between blossom blight and fruit rot gave inconclusive results due to dry weather. Very few peaches were infected with the brown rot fungus in any of the plots.

Peach Scab - an extensive experiment, using Southland peach trees at Trenton, South Carolina, gave very conclusive results. The importance of a sulfur spray 4 to 6 weeks after petal fall was redemonstrated. The results indicated further that properly applied in adequate amounts per tree, sulfur used alone gave satisfactory control of peach scab. The addition of lime did not enhance the control. The antibiotic material, endomycin, and a new organic preparation, pyridianethione, proved to be completely ineffective for the control of peach scab.

Peach Constriction Disease - Using a recently constructed and highly effective inoculation chamber, it was possible for the first time to produce typical lesions on uninjured peach twigs. Spores from pure cultures of Diaporthe were used in this experiment. The results represent a definite advance in the study of this vexing trouble, proving, as they do, that the fungus Diaporthe can act as a true parasite and attack uninjured twig tissue.

Rust Fungi Attacking Prunus - Continuing the basic studies on the life history and worldwide distribution of the prunus rust Tranzschelia, inoculation experiments have been carried on with material from Ecuador and Israel. All material is brought into the United States on Plant Quarantine permits and is used only in the laboratory. These experiments have demonstrated that the rust on Capulin cherry in South America does not infect the peach. The alternate host of the peach rust Anemone coronaria growing wild in Israel was infected by the rust that attacks peaches throughout the world.

Plans - Work during the coming season will be concentrated on control of the bacterial spot disease of the peach, using various antibiotic materials. Materials will be applied as sprays and as injections into the trunk tissues. Further experiments are planned in South Carolina for the control of peach scab fungus.

Publications

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Small Fruits and Grapes

Grape Virus Diseases - Research on virus diseases of grapes has been started at Fresno, California, for vinifera grapes, and at Beltsville, Maryland, for eastern grapes. There is considerable evidence that Pierce's disease, long a serious disorder of grapes in California, is indigenous in Florida and other parts of the southeast and has destroyed all attempts to establish bunch grapes in that area. The natural distribution of this disease, its relation to other virus diseases in the area, its hosts and vectors, plus grape variety and species resistance, and breeding for resistance all need careful study.

Strawberry Diseases - At Beltsville, foundation virus-free stocks of 7 additional eastern varieties were distributed to 4 cooperating nurseries and a total stock estimated at 300 to 400 million plants of 27 varieties will be available to growers this winter. In addition, virus-free plants of 4 additional varieties were obtained. Three of these are to go to cooperating nurseries next spring. The fourth will be propagated at Beltsville for an additional year before it goes to nurserymen. Hot-air treatment of infected plants at 99°F. for 9 and 10 days appears to inactivate virus in about 80 percent of the treated plants that survive and virus-free plants of 3 additional Pacific Coast varieties have apparently been obtained by this method. Nurseries and state agencies will take over the maintenance of virus-free stocks, except for a nucleus that will be maintained for a time in screenhouses at Beltsville, Maryland.

All virus-free strawberry varieties have been re-propagated free of plant-parasitic nematodes, and cooperating nurseries have set between 30 and 35 acres of the 27 varieties in soil fumigated twice to kill nematodes. These stocks (5 to 10 million plants) are to be sampled to determine whether they are substantially nematode-free, and then half made available to other nurserymen for foundation stocks. In Oregon, plants of a number of important commercial strawberry varieties free of viruses, nematodes, and all identified root diseases are being grown in steam-sterilized soil in a screened plant propagation center; these plants will be distributed to plant propagators to be used as nuclear disease-free foundation stocks.

Hot water experiments have established the temperature-time death points of endoparasitic nematodes in strawberry roots. Thus, a temperature of 127°F. for 2 minutes kills these nematodes and does not destroy the use of the plants for propagating stocks, provided the plants are fully dormant at the time of treatment. Nurserymen can now have a practicable method of freeing their planting stocks of root nematodes.

Inoculation experiments with strawberry plants indicated that severe injury results from infestation of meadow nematode on the roots. Non-inoculated controls grew much better than infested plants. Runner plants from nematode-inoculated plants pegged into sterilized soil recovered and grew similar to nematode-free control plants.

Tests are being continued to determine the resistance of different strawberry varieties to the different strains of the red stele root disease and to determine the strains of the disease present in Eastern States.

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Tests of the response of 8 varieties to viruses 1 and 2 and of 3 varieties to virus 1, 2, and 1 / 2 as compared to virus-free stocks are under way.

Blackberry and Raspberry Diseases - A limited survey of blackberry and raspberry roots indicates that the nematode problem may be as serious as in the strawberry. The tolerance of raspberry roots to hot-water treatment is apparently very great. In an experiment, 56 percent of untreated raspberry root cuttings developed into new plants. Twenty-eight percent of similar cuttings heated in hot water at 121° F. for 15 minutes and 20 percent of cuttings heated 124° F. for 15 minutes survived and developed into new plants. The thermal death point of root nematodes in strawberries at 121° F. is 7 minutes and at 124° F. is 3 minutes. The nematode condition of these treated raspberry plants has not been definitely established.

Blueberry Diseases - In cooperative work in New Jersey, final proof was obtained that the same stunt virus occurs in wild highbush, the dryland lowbush, the deerberry, and the cultivated blueberry. Surveys show that this virus is in the wild dryland lowbush in New England and Pennsylvania as well as in New Jersey, Maryland, Virginia and North Carolina. Further work was conducted on ring spot, shoestring, and mosaic viruses and mummy berry control.

Cranberry Diseases - In cooperative studies in New Jersey, excellent control of fruit rots was obtained by 3 sprays of either manzate, zineb, or ferbam.

Plans - Indexing strawberries in the search for virus-free plants will be reduced, as we now have virus-free stocks of nearly all important varieties. Further attempts to inactivate virus in plants of strawberry will be made. The study of the injury caused by nematodes and their role in causing strawberry black root will be continued. The possible resistance of strawberry varieties to nematodes will be determined. A survey will be made of nematode problems on brambles. Studies on virus diseases of grapes, recently initiated, will be continued. Other lines of work will be continued along present lines.

- C. Proposal for Committee Consideration. 1. Expand research on virus diseases of fruits. There is great need for the establishment of regional repositories for virus-free stocks of deciduous tree fruits. One of these should be established in the West, another in the East. The regional research committees dealing with virus diseases of stone fruits

are making progress in looking to the establishment of such repositories. Horticultural Research Crops Branch should be an active participant in such repositories to insure maximum utilization of virus free stocks by all public and private agencies engaged in fruit virus research.

Little work, either state or Federal, is being done on the important virus diseases of raspberries and blackberries, although these are known to cause substantial losses. American bunch grape production in the southern states appears to be limited by the presence of Pierce disease virus. Thus, there is great need for expansion of virus disease research both with stone fruits and with brambles and grapes.

2. Expand work on basic nutrition of fruit trees, particularly in evaluating leaf analyses as a guide to fruit tree fertilization. Research of the past decade has fully demonstrated the value of leaf analyses in diagnosing nutrient needs of fruit trees. The data are widely scattered and often incomplete. There is great need for bringing together available information on the levels of nutrient elements in the leaves associated with optimum production and making such information available to fruit growers. In many cases additional research will be needed to complete these studies.

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Nut Crops Diseases

Pecan - Investigations made during the year on the pecan scab fungus showed: (1) The minimum time required for the start of germination of pecan scab spores at 25° C was 2 hours; near-maximum germination occurred in 8 hours; (2) pecan scab spores held at 25° C germinated at relative humidities no lower than 99.6%. The importance of night dews in permitting scab infection is indicated; (3) viable scab conidia were obtained from shucks held outdoors for 11 months; (4) successful cross-inoculations of scab were secured between two pecan varieties in greenhouse and field tests, using inoculum from nut shucks; and (5) twenty fungicides were screened for eradicant potentialities in pure culture and small-scale field trials. Some of the materials were outstanding.

In the orchard, pecan scab was effectively and economically controlled in 1953 by 4 to 6 spray applications of bordeaux mixture, Zerlate or Dithane-Z-78 applied as dilute solutions or mixtures with hydraulic machines or as 3 x concentrates and applied with mist blowers or speed sprayers. Velsicol 50-61-46, a new fungicide that was promising for control of pecan scab in 1953, caused rather severe injury to the foliage in 1954.

In the very dry 1954 season, certain fungicides such as bordeaux and low-line bordeaux, greatly increased the effects of drouth injury on pecans in Georgia and elsewhere. This injury resulted in greatly reduced size of nuts and premature defoliation of the trees. On the other hand, the effect of certain other fungicides such as Zerlate, and Dithane-Z-78 were outstanding in that no reduction in size of nuts resulted from application of them. In addition, the foliage on such sprayed trees was retained in excellent condition.

In Louisiana, a bordeaux spray application for the control of foliage diseases was made on April 26, and other trees received a spray at intervals thereafter, until May 28. Some plots received two applications. The earliest spray, April 26, was too late to prevent the initial infection of downy spot, but prevented further infection and controlled liver spot. No appreciable brown leaf spot or vein spot developed in the orchard on unsprayed trees. Bordeaux applications on May 6 and on May 17 gave commercial control of liver spot, and held late infections of downy spot to commercial control. The application made on May 28 was too late to effect commercial control, although this treatment was much better than the check. There was no difference in control of foliage diseases with a second application of spray, the early application being as effective as the two.

Walnut - Further investigations on the efficacy of concentrate sprays 2X Yellow Cuprocid (2-100) for the control of walnut blight were carried on in 1954. Three applications of this concentrate proved equally as effective as the standard diluted standard spray mixture (Yellow Cuprocid 1-100). A substantial saving in the time required to spray the orchard resulted from concentrate "speed" spraying.

Field experiments on the control of walnut blight by spraying with antibiotics were also initiated in 1954. Agrimycin, a mixture of streptomycin and Terramycin, was applied at the rate of 100 p.p.m. of streptomycin plus 10 p.p.m. of Terramycin. Three applications gave very good control in 1954, reducing the incidence of infected nuts from 18.4 percent to 2 percent. Under the same conditions, 3 applications of a 2X Yellow Cuprocid Concentrate (2-100) reduced the incidence of infected nuts to 1.4 percent. No foliage injury was observed in the plots sprayed with the 2X Yellow Cuprocid concentrate spray.

The importance of black-line in the decline and death of grafted walnut trees in Oregon was shown by the results of an individual tree survey made in 32 walnut orchards in western Oregon. In all, 9,190 Franquettes grafted on black walnut roots (mostly J. hindsii), and 2,213 Franquettes grafted on Persian root-stocks were surveyed in 1954. In Franquettes grafted on black walnut rootstocks; 1,065 new cases of decline, or 10.5 percent were found. Only 89 new cases of decline, or 4 percent, of the Franquettes trees grafted on Persian walnut roots were found. Eight-hundred forty-eight of the trees, or 79 percent, of those declining on black walnut roots were affected with black-line, while none of those on Persian walnut roots were affected with this disorder. It is evident from these data and from those of previous years that black-line is the greatest single cause of the decline and death of grafted walnut trees in Oregon. In general, root rots were found to be comparatively unimportant. The black-line disorder occurs only in Persian walnuts grafted on black walnut rootstocks.

Plans - Disease control work will be continued as before. It is planned to make arrangements for the application of concentrated fungicides by aeroplanes in an attempt to control pecan scab and foliage diseases.

Publications

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INSECTS IN RELATION TO VIRUS DISEASES OF FRUITS - ENT

Progress and Finding - 1954 Recommendation. "Expand work on the relation of insects to numerous viruses of tree, bush and small fruits." (3/18)

Peach mosaic insect-vector studies were expanded with the employment of an additional professional worker to cooperate with the Colorado Agricultural Experiment Station. Scarcity of aphids in experimental plots in Maryland prevented studies on the relation of these insects to virus diseases of strawberries. Consideration is being given plans for initiation of work on insects in relation to the transmission of grape diseases.

In Georgia, readings on a 3-year experiment showed that natural spread of phony peach may occur from May through August, at least. Trees exposed between October 1 and April 1 did not become infected. It was found, too, that incubation period of the disease in the host plant is frequently as long as three years, rather than only two years as previously accepted as the usual rule. This information is necessary in evaluating the results of spray programs and other practices employed to reduce the spread of the disease. Toxicity tests indicated that none of the newer organic insecticides have residual effectiveness at all comparable to that of DDT for controlling leafhoppers, the known vectors the phony peach virus. Some of the materials were quite lethal for 2 or 3 days, but lost effectiveness thereafter. Continued studies of the habits of the insect vectors indicate that June and July may be important months from the standpoint of scheduling insecticide applications and suggest that clean cultivation may bring about a material reduction in the numbers of the insects occurring in the orchards during the critical period when most of the natural spread occurs.

Control through the use of insecticides of the spread of the x-disease virus, which causes a tree decline and killing in peach and little-cherry in sweet and sour cherry, hinges on a knowledge of the life history of the leafhopper vectors. In Oregon and Utah these life history studies were brought a long way towards completion during the year. The findings most significant to control efforts include (1) determination in Utah that the vectors there overwinter in the egg stage, largely in stems and leaves of low growing plants such as alfalfa or in fallen leaves from such plants, and with a few eggs in fallen leaves of fruit trees, and (2) the charting in Oregon of how vectors originate in ground cover growth, most of the disease carrying insects coming from alfalfa fields, pastures, or roadside vegetation in the vicinities of orchards. The next approach to the insecticidal control of the insect vectors thus should be to extend the spray or dust applications to these growths. In cooperative peach and cherry plots in Oregon it has been found that treatments applied to the orchard trees without regard to ground cover plants are not adequate to halt disease spread.

Cooperative laboratory experiments in Oregon showed that several chemicals, particularly malathion and parathion are effective against the leafhopper vectors of the x-disease virus, at least under controlled conditions.

In Utah there were completed experiments, conducted in cooperation with plant pathologists, showing that the wilt and decline of cherry, an important disease in that state, is produced by the x-disease virus, that it is in fact a phase of the x-disease-little-cherry disease, and is transmitted by the same leafhoppers.

In cooperative experiments in Washington the lead indicating that the x-disease virus may be present in the antelope brush and be carried from that host to orchards, was followed. Positive proof has not yet been secured.

In work with peach mosaic, efforts were continued to incriminate the thusfar unknown insect vectors. This year there was a division of work between the projects in California and Colorado, with emphasis in California upon the tiny eriophyid mites, and with Colorado workers continuing to try aphid suspects.

Plans - New experiments in the control of phony peach x-disease in peach and the little cherry disease by killing vectors with insecticides will stress extending the spraying and dusting to borders of orchards and to adjacent fields. Also there will be work to determine the effect on the incidence of the diseases of grower management practices in and near orchards. Cooperative work will be continued in Washington to establish whether certain wild plants, such as antelope brush, are actually hosts of the x-disease virus, and thus represent a hazard. In further studies of how the leafhoppers function in transmitting the x-disease virus, emphasis will be placed on finding exactly where they secure the virus - whether as is suspected they can extract virus only where symptoms are showing. This will supplement studies by plant pathologists to learn the effects of the systematic cutting away of the symptom-showing portions of peach and cherry tree - whether this reduces spread or whether it has an adverse effect on disease control. With the peach mosaic problem in no wise abated, it is planned that efforts to learn its mode of insect transmission be continued in California and Colorado. Experiments to determine the possible effectiveness of systemic insecticides for control of aphid vectors of virus diseases of strawberries will be undertaken if infestations permit. Work will also be initiated, in cooperation with the Horticultural Crops Research Branch, to determine the presence of Pierce's disease and other diseases in Eastern grapes and the role of insects in the transmission of these diseases.

0. Proposal for Committee Consideration - Expand work on the relationship of insects to the numerous viruses of tree, bush and small fruits to permit more rapid solution of these important problems. Needs include:

- (1) acceleration of studies of the habits and control of the insect vectors of phony peach and western x-disease, including related and/or associated strains,
- (2) studies to determine the vectors of additional stone and small fruits in various sections of the U. S., especially in the East and Midwest to complement studies in other areas,

(3) studies to determine the role of insects in the transmission of virus diseases of grapes to complement the work of the pathologists and plant breeders in the East and Southeast, and

(4) expand studies to provide for determination of the aphid vectors of virus diseases affecting strawberries, including determination of their host plant limitations and dispersal range; also to develop methods of using aphid vectors to expedite indexing strawberry plants for virus disease infections and to control the vectors, especially on certified plants in nurseries.

Publications

Transmission of the Western X-Disease from Sweet and Sour Cherry to Peach by Two Species of Leafhoppers. H. R. Wolfe and E. W. Anthon. Jour. Econ. Ent. 46(6): 1090-1092, Dec., 1953.

POME FRUIT INSECTS - ENT

Progress and Findings - 1954 Recommendations, "Expand research on insect resistance to new insecticides." (7/18)

No additional funds available. Program carried on at about previous levels.

Indications of increased resistance to DDT on the part of the codling moth continue to appear in various parts of the country. Thus far this condition is very local, and DDT is still giving outstanding control for the great majority of growers. In Indiana field-laboratory tests, one strain of larvae secured from Yakima, Washington seemed to be definitely more resistant to DDT than other strains of larvae that had been collected from either midwest or other Yakima orchards. Whether this strain had recently become resistant, or whether resistance had always been present, cannot be determined.

Field and laboratory tests for codling moth control have been carried on at Vincennes, Indiana, Kearneysville, West Virginia, and Yakima, Washington, mostly under conditions of light worm infestation. These tests have indicated several materials that could be considered for use if resistance to DDT should become general. Among these materials are Diazinon, ryania, and malathion, although the last-mentioned material breaks down rather rapidly. In West Virginia two types of black-light insect traps were found ineffectual for codling moth control.

1954 Recommendation, "Expand work to provide for a basic study of orchard and small fruit mites in order to develop more satisfactory control programs." (9/18) No additional funds available. No additional basic work undertaken.

Field program on mites continued at about its former level. In West Virginia a reduced dosage seasonal schedule of acaricides proved successful in controlling European red mites and Bryobia mites and was superior to a suppressive schedule applied after populations had increased to a threatening level. Diazinon was outstanding. It also gave complete control of green apple aphids. Stayman trees heavily nitrated supported about 30 percent more European red mites than trees unnitrated. The period from July 1 to July 25 when leaf nitrogen is highest, was the most difficult period to reduce mite populations substantially with acaricides. In Washington, tests with acaricides showed that combinations, particularly with Aramite, are very effective, and that Diazinon or Pirazinon used alone are quite effective. In Indiana, parathion and EPN were ineffective in mite control. Aramite was highly effective for both species present. Good control of all species of mites also resulted from applications of DMC and malathion. Ovotran readily controlled European red mites but allowed high populations of the two-spotted mite to build up. Demeton (Systox) continued to be one of the most effective miticides used. Systemic phosphate insecticides 12008 and 12009 developed by American Cyanamid Company were highly effective in controlling European red mites 8 days after application where 47% solutions were used at 1/2 pint to 100 gallons. Their efficiency had dropped by the end of 21 days. Neither material was as effective as demeton at 1 pint.

1954 Recommendation, "Initiate Studies of deciduous fruit insects under south-western conditions." (10/18) No funds made available; no work initiated.

1954 Recommendations, "Expand the work on insecticide residues on and in crops and soils, and on their effect on flavor and quality." (12/18) Additional funds available to Branch in FY 1955. Facilities are being expanded, but work on fruit insects during calendar year 1954 will remain at about former levels. Spray residues are being determined from all plots where information on residues is needed and analytical methods are available. Some expansion is possible in this work in calendar year 1955 if needed.

The finish of fruit sprayed with Diazinon, 3 pounds to 100 gallons throughout the season, was definitely inferior to that obtained with most of the other insecticides. On Golden Delicious Diazinon applied at calyx time and in 8 cover sprays it caused severe russet. Diazinon

roughened the skin of Grimes Golden, Rome and Turley; and red varieties, such as Rome and Turley, had a dull color at harvest. Diazinon also left a heavy, white visible deposit on the fruit at harvest. Malathion, used alone on Golden Delicious at 3 pounds to 100 gallons, produced an excellent finish, better than that secured with DDT. Captan was used as the fungicide on the finish study plots. DDT (50%) at 1-1/2 lb. to 100 gallons, plus parathion (15%) 1/2 lb., starting with the second cover, did not cause severe russet where used on Golden Delicious.

An unusually severe outbreak of rosy apple aphid in southern Indiana provided an opportunity to observe and study control measures for this pest. In commercial orchards best control was secured where dinitro sprays were applied during the dormant period. TEPP (40%) at 1/3 pint to 100 gallons was highly effective in controlling rosy aphids, when applied before the leaves become curled. The systemic insecticide demeton (23%), at 1 pint to 100 gallons, killed a higher percentage of rosy aphids in tightly curled leaves than TEPP. Spraying limbs of the bottom half of a tree with demeton did not appear to reduce the number of aphids present in the upper portion of the tree.

An outbreak of the green apple aphid on young apple trees just coming into bearing was treated with 9 different organic phosphate materials, several of which were systemic. All the materials was highly effective in reducing the number of infested terminals and all reduced the number of aphids present per colony; however, the systemics demeton, 12008 and 12009 gave perfect control.

Continued studies of the effect of pesticides on the natural enemies of the insects and mites that attack pome fruits in eastern orchards confirmed that ryania has a low order of toxicity to certain predacious mites, the most important natural enemies of the injurious mites, and is promising for codling moth control. Neither early season applications of the fungicides glyodin, glyodin plus mercury and captan, nor a delayed dormant application of an oil alone or with a dinitro insecticide reduced populations of these beneficial mites. As used in the petal-fall and first cover sprays methoxychlor and dieldrin were less harmful than lead arsenate. Under commercial conditions predaceous mites did not increase in numbers sufficiently during the season in which ryania was first substituted for DDT in the codling moth control program to avoid need for application of an acaricide. It is anticipated the beneficial forms will be more numerous and effective another season.

The evaluation of mist blower type of spray equipment was continued in southern Indiana. Codling moth control was unsatisfactory where concentrate sprays were applied and Forbes scale infestations began to build up, even though parathion was included in eight cover sprays. Residue analyses made for DDT show that the poorer control can be attributed to inadequate and irregular deposits on the trees in the concentrate plots.

Tests are in progress to determine the effectiveness of several fungus diseases for the control of the codling moth. These tests include both laboratory studies and field spraying in an apple orchard. In laboratory tests, consistent mortality of mature codling moth larvae was obtained with two fungus diseases. Studies with other disease organisms are also in progress.

Plans - Program will be carried forward at about present level. Special emphasis will be placed on the possible resistance to DDT of the codling moth and other pome fruit insects, on new insecticide that might be substituted for DDT, on systemic insecticides, on the effect of insecticides on the natural enemies of fruit insects and mites.

- E. Proposals for Committee Consideration - Expand studies of insect resistance to insecticides, especially to determine the basic facts responsible, to aid in developing means of preventing or overcoming it. Thorough fundamental studies of insect physiology are particularly needed to provide avenues of approach to a practical solution of the problem. The alternative is heavier and more frequent applications of presently known insecticides or discovery of more potent materials, either of which may lead to serious residue problems.

The problem of resistance of insects and mites to pesticides used for their control on tree fruits, small fruits, and berries, particularly strawberries, becomes more serious each year. More and stronger applications of DDT are being made for codling moth control in an increasing number of orchards, resistance of mites to parathion and other phosphate materials is increasing and leafhoppers on apples, grapes and cranberries are not being controlled as effectively with DDT as formerly.

- F. Expand work on systemic insecticides for use to control pests of tree fruits and nuts, small fruits and berries. Available systemic insecticides have given promising results, particularly when applied as full coverage sprays, in the control of aphids, mites and fruit flies. Studies to determine the nature and persistence of their residues and their effect on fruit quality and flavor should be accelerated, including development of more precise methods for determining residues. Studies should also be expanded to reveal additional

materials of systemic value that will affect a wider range of pests, including leaf feeding forms, borers and others. This should be a major, long range program. Numerous Federal and State workers are giving incidental attention to work with systemic insecticides but a more intensive program is needed to expedite the development of this type treatment and determine its practical value.

Publications

The Effect of Continued Widespread Use of Organic Insecticides. D. W. Hamilton, Proc. Ind. Academy of Science 63:190-194, 1953.

Biology of the Red-Banded Leafroller. D. W. Hamilton & S. A. Summerland, Jour. Econ. Ent. (In press)

Summer Control of Pear Leaf Blister Mite. H. P. Lancaster, Jour. Econ. Ent. (In press)

Development of Fruit Insect Control in Washington. E. J. Newcomer, Better Fruit (In press)

Present Status of Codling Moth Control in the Midwest. D. W. Hamilton, S. A. Summerland & J. E. Fahey, Trans. Ind. Hort. Soc. (In press)

Natural Factors Affecting Abundance of Codling Moth Larvae. D. W. Hamilton, Proc. North Central Branch Ent. Soc. Amer. 9:38-39, 1954.

SMALL FRUIT INSECTS - ENT

Progress and Findings - 1953 Recommendations. "Expand work on the relation of insects to numerous viruses of tree, bush, and small fruits." (3/18) See discussion under heading "Insects in Relation to Virus Diseases of Fruits," page 23.

"Expand work to provide for a basic study of orchard and small fruit mites in order to develop more satisfactory control programs." (9/18) No additional funds made available and no basic studies possible in 1954.

One application of the systemic insecticides -- demeton, methyl Systox and schradan -- gave promising control of spider mites and associated infestations of the strawberry aphid on strawberries in California. Other insecticides showing promise included dusts containing Ovotran, Aramite and FW-293 (Rohm and Haas). Parathion, malathion and

Metacide gave satisfactory control of the strawberry aphid, but their use led to an increase in cyclamen mite infestation. The cyclamen mite continued to present a difficult problem on strawberries in southern California. Emulsions containing ethylene dibromide or ethylene chlorobromide caused injury to strawberry plants and were ineffective in controlling this mite. Methyl bromide fumigation continued to control it satisfactorily but is too expensive for general use.

In small-scale tests in Maryland, the systemic insecticide alkyl mercaptomethyl dithiophosphate (Compound 12008) gave excellent control of the cyclamen mite infesting strawberries when applied at rates of 50 to 100 pounds per acre to potted plants.

The systemic insecticides schradan and demeton (Systox) gave promising control of the resistant strain of the two-spotted spider mite on strawberries in Maryland, in experiments started during 1953. Strawberries harvested in 1954 from the plants treated in 1953 showed no residues of schradan or demeton by chemical analysis. This suggests that these two systemics could be used on newly set strawberry plants during the first season and not incur a residue hazard on fruits produced the following year.

Plans - The program will be continued at about its current level. Special attention will be given to experiments for the control of the cyclamen mite.

G. Proposal for Committee Consideration - Expand research on the development of methods for controlling mites on strawberries. To prevent wide distribution of such pests to commercial plantings methods should be developed for use by nurseries to disinfest plants carrying strains of the two-spotted spider mite resistant to various miticides and to control the cyclamen mite. This work is urgently needed to supplement work under way by the plant breeders.

Publications - None

STONE FRUIT INSECTS - ENT

Progress and Findings - Work was continued at a moderately reduced level as compared to 1953 due largely to the lack of damaging populations of the more serious pests. A minor expansion resulted from initiation of preliminary studies of cherry fruit flies in northern Ohio in cooperation with the Ohio Agricultural Experiment Station. Continuation of tests of soil insecticides for cherry fruit fly control in Washington pointed to the possible superiority of isodrin, 4 pounds per acre, or endrin, 16 pounds per acre, to other soil insecticides.

The oriental fruit moth is now controlled readily with DDT and several of the phosphate insecticides. In Washington its control presents no problem and a survey in 1954 indicated it has not spread from the rather limited area where it was first found in 1948. In New Jersey again phosphate-type insecticides applied three times in large experimental blocks, starting at shuck-split, as used to control plum curculio, greatly reduced early oriental fruit moth populations and resulted in from 87 to 95 percent control without additional applications. In small replicated plot tests, harvest injury of fruit was greatly reduced by two preharvest sprays of parathion, methyl parathion or chlorothion but not by a combination of half the customary amounts of parathion and DDT. Again, as in 1953, an attempt to find a formulation that would extend the effective period of toxicity of parathion on orchard trees was unsuccessful.

In Georgia soil insecticides continued to show promise for controlling the plum curculio. Aldrin was found to remain effective for at least 24 to 26 months and heptachlor for 12 to 13 months. In a large preliminary field test aldrin as a soil treatment at 4 pounds per acre reduced the adult curculio population and there was also a reduction in the infestation in the fruit at harvest. Granular and dust formulations of aldrin were about equally effective and were superior to an emulsifiable concentrate. Parathion, malathion and dieldrin were highly effective against adult curculio. EPN, aldrin, heptachlor and Compound CS-728 (a product containing 50% of a chlorinated product of 1-p-chlorophenyl-1-phenyl-2-nitrobutane) also gave good control of a light infestation. No malathion residue was found on ripe peaches that received 5 applications of that material, the last 2 weeks before harvest. Residues on harvested peaches following use of dieldrin at 1/2 and at 1 pound per 100 gallons of spray in the first three applications of a 5-application schedule were 0.25 and 0.24 ppm, respectively.

Concentrated sprays applied with a mist blower again failed to control adult plum curculios as well as when the same insecticide was applied as a dilute liquid spray with hand guns.

Trunk sprays now in wide use for peach tree borer control failed to afford adequate protection under conditions of heavy infestation in Georgia where the moths lay eggs over a long period. DDT and BHC were superior to parathion for peach tree borer control and parathion and EPN were superior to malathion for lesser peach tree borer control. Ethylene dichloride emulsion was effective against the peach tree borer regardless of the degree of infestation as was a trichlorobenzene emulsion, but the latter caused some injury to 2-year old trees. DDT was somewhat superior to BHC and definitely superior to parathion in preventing peach tree borer infestation in peach nursery stock.

In many areas insects that cause catfacing of peaches cause more injury than all other pests of this fruit. Such injury, especially when the tarnished plant bug and plum curculio are primarily involved, can be prevented quite satisfactorily by making early season applications of dieldrin. When stink bugs are the most important species concerned, no satisfactory method of control is available. Studies under way involve timing of treatments as well as tests to find an effective insecticide.

Improvements in rearing techniques permitted increased colonization of two introduced Chinese parasites, Agathis festiva and Phanerotoma grapholithae, of the oriental fruit moth in new areas. Twenty three sites were colonized in Washington County, Maryland, and nearby counties in West Virginia. Recovery collections from colonized sites in Connecticut, the Hudson River Valley, New Jersey, the Maryland-West Virginia District, and western North Carolina to determine establishment were not encouraging. Low host populations undoubtedly had a bearing on establishment and spread of the parasites.

Plans - It is expected that work on stone fruit pests will continue at about the present level.

Publications

The Propagation of Horogenes molestae, An Asiatic Parasite of the Oriental Fruit Moth, on the Potato Tuberworm. H. W. Allen, Jour. Econ. Ent. 47 (2): 278-81, April 1954.

A Leaf Roller, Platynota flavedana Clem., Attacking Peaches. D. W. Hamilton, Jour. Econ. Ent. 47 (5), October 1954.

Control of Georgia Peach Pests in 1953. O. I. Snapp, Jour. Econ. Ent. (In press)

Field Insects of Peaches Affecting Market Quality. O. I. Snapp, Proc. 6th Ann. S.E. Short Course, University of Georgia, pp. 22-24, November 1953.

NUT INSECTS - ENT

Progress and Findings - In a randomized field experiment against the shuckworm in Georgia, 3 sprays of 2 pounds of 25 percent EPN wettable powder per 100 gallons applied during the period August 6 to September 2 held infestation in the shucks at harvest to 25 percent compared to 99 percent on the unsprayed check trees. Other treatments were less

effective. The quality of nuts harvested from the trees receiving the above treatment was significantly superior to the quality of those receiving other treatments or the check. Nuts from the check trees had little or no commercial value. Forty-seven percent of kernel was found in nuts receiving the above treatment, while only 38 percent was found in nuts from untreated trees. Only 57 nuts (shell and kernel) from trees receiving the above treatment were required to weigh one pound while 70 nuts were required from the untreated trees.

In Florida results obtained in field experiments during 1953 for control of hickory shuckworm support the results reported from Georgia. They indicated that two late-season (late August and mid September) applications were almost as effective in reduction of shuckworm infestation on Mahan variety pecans at harvest as were two early-season (early and late June) and two late season applications or six consecutive applications at three week intervals (June 4 - September 17). Under conditions in which 93% of the shucks on untreated trees were infested by an average of 3.2 shuckworm larvae per shuck at harvest, EPN was the most effective material used. The two late season applications of EPN gave a reduction of 54% in infested shucks, with an average of 1.6 shuckworm larvae per infested shuck. Parathion was not as effective against the shuckworm as EPN but was more effective than malathion at the concentration used. In another experiment for control of shuckworm on Moore variety pecans, two late-season applications of parathion gave 53% reduction in infested shucks at harvest under conditions in which 87% of the shucks were infested in the unsprayed check plot.

The results of 1954 tests of EPN and a combination of DDT and parathion in Florida and EPN, parathion, Chlorothion and Methyl parathion in Georgia in a variety of schedules are not yet available.

Results of tests in Georgia indicate that application of insecticides to the soil may aid in the control of the pecan weevil. Fewer adults were found in trees in 1954 that had received soil treatments of heptachlor and dieldrin at 5 pounds per acre during the summer and fall of 1953, than were found in untreated trees or in trees treated with aldrin. In 1953, the trees that had received the aldrin treatment yielded fewer weevils than untreated ones and had fewer infested nuts at harvest. 1954 harvest results are not yet available.

Good results were obtained in tests conducted with conventional sprays for control of the pecan nut casebearer. In Florida parathion gave good control and was slightly superior to methyl parathion and EPN. Against a light infestation in Louisiana both methyl parathion and malathion gave satisfactory control. In Texas, a concentrated spray of parathion applied by a helicopter was less effective than a conventional spray application of DDT.

An early season application of the systemic insecticide demeton failed to give satisfactory control of the pecan phylloxera while benzene hexachloride was slightly superior to malathion. The effective period for application of benzene hexachloride was found to be about 10 days.

EPN, parathion, Chlorothion and methyl parathion, as used to control the hickory shuckworm in Georgia, were effective in suppressing infestations of the black pecan aphid for a period of 3 to 4 weeks following the last application. In Louisiana aeroplane applications of concentrated sprays of parathion gave good control of this aphid and are believed to be practical for such use under commercial orchard conditions.

Aeroplane applications of concentrated sprays of parathion also controlled heavy infestations of the mite Tetranychus hicoriae in Louisiana. When ground applications of dilute liquid sprays were made with a speed sprayer a single application of demeton was equal or superior to two applications of either parathion or malathion. Two spray applications of either parathion or malathion were required to prevent damage by this mite in Louisiana during July and August. In preliminary tests to control T. hicoriae in Florida a single application of either parathion, methyl parathion, malathion, demeton and p-chlorobenzyl p-chlorophenyl sulfide effected satisfactory reductions of the active stages.

Plans - Present indications are that work on pests of tree nuts will again be confined to pecans and continue at about the present level. Major attention will again be given to the hickory shuckworm, pecan weevil, aphids and mites and methods of applying sprays. With the establishment of a Branch regional insecticide laboratory in the Southeast, it is hoped studies of insecticidal residues on ground cover in pecan orchards in relation to the use of the orchards for pasture can be initiated.

Publications

Insects and Diseases of the Pecan and Their Control. M. R. Osburn, A. M. Phillips, W. C. Pierce and J. R. Cole, U.S.D.A. Farmers' Bulletin 1829, 1954.

EPN for Control of the Hickory Shuckworm on Pecan. M. R. Osburn, Jour. Econ. Ent. (In press)

Chestnut Weevil - How to Control Them. U.S.D.A. Leaflet. (In press)

The Pecan Phylloxera and Its Control. W. C. Pierce, Proc. 33rd Ann. Meet., Texas Pecan Growers' Assoc., July 13-14, 1954.

GRAPE INSECTS - ENT

Progress and Findings - The effectiveness of treatments recommended for control of the grape berry moth in the Great Lakes area has given an opportunity to reduce emphasis on work on that insect to give attention to the grape phylloxera and other pests forming galls on grapes.

Combination sprays of 3 pounds 15 percent parathion with 4-1/2 pounds 50 percent DDT wettable powders in sufficient water, 200 to 300 gallons, to spray one acre were effective in controlling the grape berry moth in Ohio. EPN and mist concentrate sprays at concentrations of 4, 5 and 6X in 50 gallons of spray per acre also gave effective control, but malathion did not. Unfortunately, currently available mist concentrate sprayers are not altogether satisfactory for the spraying of grapes.

Delaware grapes were protected from injury by the two-spotted spider mite with two applications about 7 days apart of malathion (alone and with Bordeaux mixture) parathion or demeton (Systox).

Dilute sprays of demeton, a systemic insecticide, and dieldrin failed to control a light infestation of the grape tomato gall but, in a single test of concentrate sprays, dieldrin and demeton gave some control.

The grape phylloxera appears to be more abundant and injurious than is generally realized. Preliminary tests of systemic and soil insecticides for control of this pest have been initiated in Ohio but no results are yet available. To date there has been no indication that the systemic materials controlled either the leaf or root form the first season. Soil application of lindane, BHC, dieldrin, heptachlor, chlordane and DDT, mostly at 10 and 20 pounds per acre, have not injured either field grown or potted vines.

Plans - Work to be continued along 1954 line.

- H. Proposal for Committee Consideration - Expand studies of the grape phylloxera to include control of the root-infesting form on both western and eastern type grapes. A treatment for control of the leaf-infesting form on eastern grapes has been developed but more support is needed to permit the research necessary to make an adequate study of the control of the root-infesting form. This pest is still widespread in western type grape vineyards and is a limiting factor in the establishment of certain improved varieties in eastern vineyards.

Publications - None

PRODUCTION PRACTICES, MATERIALS AND EQUIPMENT

APPLE AND PEAR CULTURE, NUTRITION, FRUIT SET, FRUIT THINNING - HC

Progress and Findings - 1954 Recommendation "Initiate a national program of leaf analysis to determine nutritional levels associated with quality and quantity of fruit and nut production" (6/18). Available resources did not permit carrying out this recommendation.

Absorption of nutrients through bark - Studies on the absorption and translocation of nutrient salts by bark tissues were conducted at Beltsville for the third consecutive year. Results obtained in 1954 confirm previous findings in that no absorption or translocation took place in normal uninjured bark while the trees were dormant. Rapid translocation again took place during the early growth period when radioactive phosphorus as $\text{KH}_2\text{P}^3\text{O}_4$ was applied to injured or uninjured bark on the trunks of dwarf apple trees grown indoors. Highest concentration of radioactive P was found in the flower parts and young developing leaves. The presence of moisture was necessary for the absorption of the salt into uninjured bark. When needle punctures were made in the bark the nutrient salt was absorbed while the tree was dormant but no translocation took place until active growth began. This study explains the beneficial results that growers have obtained in the Pacific Northwest and California from spraying fruit trees in the late dormant season with strong solutions of zinc to control zinc deficiency. No further work on this particular phase of the problem is contemplated.

Fruit thinning with naphthaleneacetic acid (NAA) - In conjunction with studies of new materials for fruit thinning, NAA was included in the tests at Beltsville. Good thinning was obtained with 20 p.p.m. on Golden Delicious at 16 and 20 days after full bloom, Delicious at 14 days after full bloom, and with York Imperial and Rome Beauty the best thinning resulted from sprays applied 27 and 25 days after full bloom respectively. The thinning of York Imperial and Rome Beauty, however, was not considered adequate from the commercial standpoint. Studies will be continued.

Physiological studies with NAA - Since the success of NAA as a fruit thinner has been quite variable, experiments in the mode of action and physiological response of the tree to this chemical were inaugurated in the spring of 1954. Known amounts of NAA labeled with radioactive Carbon¹⁴ were applied to spur leaves 24 days after full bloom. Samples of leaf, spur, seed and fruit pulp tissue were sampled at intervals,

and the distribution of C^{14} determined with the Geiger-Mueller counter. These exploratory studies indicate that: (1) most of the NAA moved out of the leaf within a period of 1 week; (2) a small amount was translocated to the spur clusterbase; (3) no activity was detected in the fruit, either in the seeds or pulp with methods applied to date; (4) some degradation of the compound took place to other forms such as simple sugars, polysaccharides and possibly $C^{14}O_2$. This work will be expanded slightly in the next year.

At Beltsville, an extensive experiment was inaugurated in 1954 to determine if there is any direct effect of a number of chemicals on fruit bud initiation. Naphthaleneacetic acid, 2,4-D, Maleic hydrazide, glucose sugar and Boron were used. Results will not be available until the spring of 1955.

'Tween 20' as a fruit thinner for apples - In 1953 Tween 20 (polyoxyethylene sorbitan monolaurate) showed promise as a fruit thinner on Winesap, York Imperial, Delicious and Golden Delicious. A comprehensive study was made at Beltsville in 1954 with this material and the results were disappointing. It proved to be too mild a thinning agent and therefore cannot be recommended. The varieties used in the experiment were Duchess, Delicious, Golden Delicious, York Imperial, Jonathan, Grimes Golden and Rome Beauty. New materials will be investigated.

Nutritional studies on mulching - Leaf analyses were conducted on trees mulched with high-nitrogen hay, straw plus supplementary nitrogen and unmulched trees fertilized with nitrogen. On the basis of percent dry weight there was no significant difference between treatments in nitrogen, calcium or magnesium. Phosphorus was slightly higher in the hay-mulched trees while potassium was considerably higher. On the basis of actual amounts per leaf, however, the hay-mulched leaves contained significantly higher amounts of all the elements including the micro-nutrients boron, iron, copper and manganese. These higher amounts per leaf simply represent larger and heavier leaves; therefore, more of the various elements were required to build the leaf. This reflects the greater capacity of hay-mulched trees to absorb and utilize more nutrients for a larger and more efficient leaf system.

Nitrogen requirement of apples - At Wenatchee, Washington, long term studies are being continued to measure the effects of varying levels of nitrogen on growth, yield, fruit size, and color of apples. Results to date indicate that applications of nitrogen resulting in a 2.3% nitrogen level in the foliage is optimum. Levels lower than 2.3% are conducive to lower production. Levels higher than 2.3% do not result in increased production but have the effect of lowering fruit color and retarding maturity.

In conjunction with these studies, leaf samples were collected in 150 orchards in North Central Washington. Nitrogen determinations will be made in order to determine the percentage of orchards lower and higher in nitrogen than the 2.3 level.

Mid-summer applications of urea sprays in Washington is a common practice among fruit growers. The objective is to obtain increased fruit size. Work was initiated to measure the effect of urea sprays on the growth rate of apples. Results indicate that growth rate cannot be effected by the addition of urea sprays applied during June and July.

Fruit thinning experiments - During the past year emphasis was placed on measuring the effectiveness of materials considered milder in their action than the dinitro chemicals. Extensive work was performed with Morpholine Thirium Disulfide (MTD) and Naphthaleneacetamide. Results with Naphthaleneacetamide were generally disappointing. A slight amount of thinning was obtained but the benefit in increased fruit size was negligible. These results agree with those obtained in 1952 and 1953. MTD failed to thin in all experiments.

Experiments to prevent preharvest drop of apples - Work was continued in order to further evaluate 2,4,5-TP in preventing the drop of apples. In comparison with NAA, 2,4,5-TP was found to have a longer duration of effect and a greater intensity of effect. Four years' results with this chemical have been prepared in publication form.

While 2,4,5-TP appears to be an ideal spray for apples when applied in dilute or semi-concentrate form with conventional spray equipment, there appears to be certain hazards connected with its use when applied with the airplane. Bartlett pears receiving drift when adjacent apple trees were sprayed developed calyx end breakdown at harvest time the year following. Also, 2,4,5-TP when applied with the airplane has caused a varying amount of bud mortality from terminal growth of young apple trees.

Studies were continued to determine the relative mobility of the various stop drop chemicals. It was found that 2,4,5-TP transmits its effect from a treated fruit to the adjacent untreated fruit. NAA does not have this characteristic.

2,4,5-TP as related to fruit set of Anjou pears - 2,4,5-TP sprays ($7\frac{1}{2}$ to 15 p.p.m.) applied to Anjou pears immediately following harvest resulted in a two-fold increased set of fruit the following year. Yields were increased by 50%.

Pear tree nutrition - At Medford, Oregon, the micro-nutrient elements as well as N-P-K are being used in this work. Good greening effect was obtained on chlorotic trees with iron sprays alone and in combination

with manganese, but only when applications were made early in the growing season. Experiments to study N, P and K in pears were started this season and no results have been obtained. In an older experiment, pear trees in sod, in clean cultivation, and in cultivation with cover crops are being compared. Trees in sods are pale in color, grow less and produce smaller crops as compared to trees that are not in sod. In the experiments the same nitrogen rates are being used on all plots. There is little indication that lack of soil moisture has been detrimental to the trees in the sod plots. Apparently trees in sod need heavier nitrogen applications than those under cultivation.

At Medford, the possible use of an electrical resistance method to determine percent of available soil moisture in the field is being investigated. The resistance blocks have been installed and readings are being taken at the same time a soil sample is taken. The soil sample is oven dried for soil moisture determination. From these data it is hoped that a soil moisture versus electrical resistance curve can be drawn which can be used in the future to determine soil moisture without oven drying a sample.

Plans - Work will be continued as indicated above. See proposals for committee consideration.

Proposals for Committee Consideration -

- I. Expand Work on Soil Moisture and Irrigation and Their Effect on Size, Finish, Regularity of Bearing and Other Factors in Apples and Peaches, Particularly Under Eastern Conditions - Successive dry years have again stimulated great interest in the value of irrigation for orchards under eastern conditions. Research conducted 20 years ago has contributed much to the understanding of the soil moisture problem. However, many questions in regard to the basic effect on moisture shortage on fruit development are still unanswered.
- J. Expand Work on Basic Nutrition of Fruit Trees, Particularly in Evaluating Leaf Analyses as a Guide to Fruit Tree Fertilization - Research of the past decade has demonstrated the value of leaf analyses in diagnosing nutrient needs of fruit trees. The data are widely scattered and often incomplete. There is great need for bringing together available information on the levels of nutrient elements in the leaves associated with optimum production and making such information available to fruit growers. In many cases additional research will be needed to complete these studies.

- K. Expand Work on Chemical Thinning of Fruits - Chemicals such as naphthaleneacetic acid, naphthalene acid amide and dinitro compounds are extensively used for the chemical thinning of fruits. All are irregular and uncertain in their action. No information is available on the basic effect of such compounds on fruit bud initiation. It is becoming almost impossible for orchardists to obtain labor for hand thinning. More work on the use of these and other chemicals in fruit thinning, emphasizing particularly the basic physiological aspects is urgently needed.

Publications -

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_____, H. N. Siegelman, B. L. Rogers and Fisk Gerhardt, Four years' results with 2,4,5-Trichlorophenoxypropionic acid on maturity and fruit drop of apples in the Northwest. Proc. A.S.H.S. (In press) 1954.

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STONE FRUIT - HC

Progress and Findings - 1954 Recommendation of the committee "Expand research on replanting old fruit sites." (8/18) - Some expansion of the work with peaches was made through adjustment of other work programs.

Replanting Old Fruit Sites: In studies at three different locations in cooperation with experiment stations in Texas it was found that methyl bromide fumigation gave beneficial results. At Stephenville and Tyler, Texas, the addition of small amounts of high magnesium lime to the soil also was beneficial. The only one of several treatments which was found beneficial at the Brownwood Pecan station was fumigation with methyl bromide. Whether this beneficial effect was due to elimination of some disease such as oak root rot or crown gall or whether it was the result of controlling such pests as nematodes is not known. In spite of some benefit from the treatment the plants still failed to grow as satisfactorily as in newly cleared land.

In greenhouse studies at Beltsville on soil obtained from the Eastern Shore of Maryland a combination treatment of methyl bromide fumigation and high magnesium lime gave significantly improved growth of trees over non-treated soil. There was some improvement in growth where high magnesium lime or calcium lime only was used and about the same improvement where methyl bromide alone was used. Where the two were combined, however, the results were very good. Calcium lime gave results equal to magnesium lime this last year. In the greenhouse studies on soils from Beltsville the high magnesium lime at approximately 1 ton per acre again gave strikingly improved tree growth but the methyl bromide had no significant effects. Based on these greenhouse studies it is necessary now to expand our work to more field tests.

In 1953 it was found that both chelated zinc and iron when applied to the soil was an effective means in correcting arsenic toxicity to young peach trees planted in old orchard soils in Washington state. During the past year this problem was studied in 8 different orchards representing a wide variety of soil types and conditions. These experiments included rates of soil applications, time of application, and the effectiveness of sprays containing chelated zinc and iron when applied during the growing season. Results conclusively showed that both spray applications (June and July) as well as soil treatments, were effective in correcting the trouble. Chelated zinc was generally found to be more effective than iron. It was generally found that a 2 lb. soil application was required on most soils. Effective sprays were at the rate of $1\frac{1}{2}$ lb. of zinc EDTA per 100 gallons.

Studies were initiated to determine the effectiveness of chelated zinc when applied to young peach and apple trees at planting time. These studies were carried on in two locations representing different soil conditions.

At Wenatchee, Washington, several experiments were initiated to study the effect of soil and spray applications of chelated zinc in correcting zinc deficiency on bearing peach, apple and cherry trees. The results in 1954 indicate only a partial correction from soil applications. Mildly affected trees showed complete recovery while severely deficient trees showed improvement. Sprays applied during the growing season show considerable promise.

Fruit Thinning: Results of thinning peaches with Carbamate sprays of various types were not so encouraging in 1954 as in 1952 and 1953. Thinning of fruits was obtained again without injury to foliage but the results with different concentrations were variable and the thinning was not sufficiently uniform on individual trees. The insides of the trees were over-thinned whereas the outsides and tops of the trees were usually under-thinned at any concentration and material which left approximately the correct number of fruits per tree. Increased size of fruits was obtained under the thinning treatments, but those thinned by hand gave a much better distribution of fruits and higher yields. Further work using these and other carbamate materials as well as other growth regulating substances will be used next season.

Dormancy Studies: Branches of 9 varieties of peaches representing low chilling and high chilling varieties were subjected to increased maximum temperature at various periods during the winter at Fort Valley, Georgia. They were exposed to approximately the same amount of total chilling as the control branches. The results showed that high temperatures in December counteract the effects of chilling. High temperatures in November were less harmful.

Growth Studies: Studies with apricots in Washington state in 1954 showed that 2,4,5-T sprays applied at the beginning of the pit hardening stage resulted in 3 days earlier maturity, and 10 to 15% increase in fruit size, and was highly effective in retarding fruit drop which may occur any time after the pit hardening stage until harvest. Should the embryo be affected by frost during, or shortly following the bloom stage, 2,4,5-T sprays will result in greatly increased yields. This condition is a result of the chemical preventing the drop of fruits effected by the frost.

Plans - Tissues will be analyzed to determine if chelated zinc and iron reduce arsenic absorption from the soil, or acts within the plant to reduce toxicity. Field work on this and other phases of the replant problem will be continued.

Work on the effects of hormone type chemicals on the development of stone fruits, particularly apricots, and on chemicals to thin peaches, will be continued.

- L. Proposal for Committee Consideration - Expand Work on Planting Old Fruit Tree Sites - Increasing difficulty is being experienced in reestablishing peaches on old peach land, yet new land on suitable sites is often not available. Limited research has indicated that soil fumigation and liming under some conditions are beneficial. Extensive field tests need to be set up to study these and other practices in connection with fruit tree replanting, particularly peaches.

Publications -

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_____, Practices that help peaches. Va. Fruit Magazine, p. 22, 1954. Reprinted from January issue of "Agricultural Research".

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SMALL FRUITS AND GRAPES - HC

Progress and Findings - 1954 Recommendation of the Committee, "Expand work on weed control in small fruits, particularly strawberries and grapes." (11/18) Due to insufficient funds, no expansion has been possible. A paper on weed control in strawberry covering previous work has been prepared.

Grapes: Rootstock tests are being continued at Meridian, Mississippi, and at Fresno, California. Propagation studies of muscadines, especially with mist sprays, are being continued in cooperative studies at Raleigh, North Carolina. Methods of grafting and budding vinifera varieties are being studied to improve the ease of establishing varieties on rootstocks. Also at Fresno, zinc deficiency studies are being continued.

Strawberry Production: At Beltsville the following experiments have been started, but results have not yet been secured. (1) Time of fall planting of Pocahontas strawberry; (2) the value of stratification of strawberry seed; (3) the response of 3 varieties of everbearers, one 2-crop variety and 2 June-bearers to short and long photoperiods; (4) planting distances for 3 varieties; (5) time of runner plant thinning for 4 varieties; (6) rest period requirement of strawberry varieties; and (7) performance of 20 varieties using plants free of virus and nematodes.

Blueberry Production: At Beltsville yields and berry size under sawdust mulch with high N, are considerable better than under clean cultivation. Also at Beltsville, the highest percentage of rooting of cuttings has been at 60°F. bottom heat while the best top growth was at 70°F. bottom heat. In seed germination studies, blueberry seed germinated more slowly but best if given no cold storage but seeded directly in flats in midwinter in the greenhouse.

Blackberry Production: Cooperative irrigation tests on 7 kinds of blackberries at Corvallis, Oregon, show somewhat higher yields for irrigation at the height of bloom as contrasted with no irrigation or irrigation at the beginning of harvest, mid-harvest, or both periods. Placement fertilizer tests are under way at Corvallis also.

M. Proposal for Committee Consideration - Expand Research on Weed Control of Small Fruits, Particularly Strawberries and Grapes - Weed control in strawberries usually represents at least half the cost of growing to harvest. It has been demonstrated that certain chemicals can be used effectively to reduce the weed control problem. The exact dosages and times of application for different geographic areas have not been accurately evaluated. Experiments need to be conducted in the various strawberry growing areas, as the weed population and growing conditions for the strawberry plants vary in each area.

Publications:

Scott, D. H., W. C. Shaw, and R. U. Ruppenthal, An evaluation of several chemicals for control of weeds in strawberry fields. Weed Jour. In press. 1954.

Harmon, F. N., A modified procedure for green-wood grafting of vinifera grapes. Proc. A.S.H.S. (In press). 1954.

Snyder, Elmer and F. N. Harmon, Some responses of vinifera grapes to zinc sulfate. Proc. A.S.H.S. (In press). 1954.

NUT CROPS - HC

Progress and Findings - Pecans - In soil management experiments in Georgia, pecan yields for 1953 continued to be as large under a supplemental grazing program of orchard management as under clean summer cultivation. The expense of the grazing practice is less and there was appreciable additional income from livestock. Pecan orchards thus managed since 1949 have had no crop failures attributable to poor nutrition and the trees show a tendency toward more uniform annual yields. Evidence secured thus far indicates that soil fertility maintenance with sod culture may be less expensive as the practice is continued.

In cultural experiments at Robson, Louisiana, the nut yield and growth of trees was significantly lower from plots with Dallis grass sod plus supplemental fertilizer than from plots with a winter legume and summer cultivation, or with winter legume, summer cultivation, and supplemental fertilizer. The weather was very dry from late spring to early fall and the sod plots apparently suffered from both moisture and nitrogen deficiencies. A reseeded winter legume will be planted in the sod plots this fall; otherwise, the experiment will be continued as set up.

In an experiment in Louisiana to determine the relative costs and time to develop a pecan orchard from transplanted trees as compared with planting seed nuts and top-working the seedlings in place, the nursery trees are very much further advanced than trees from seed nuts. A complete stand of trees from seed nuts has not yet been attained. The experiment will continue until commercial production is attained in all trees.

In an irrigation-tree spacing experiment at Brownwood, Texas, in which the stand of trees in some plots was thinned from 35 feet on the square to 50 feet on the diagonal and in which some plots were irrigated and others not, the 1953 yields per tree were higher and the size of nuts was larger, and the trees made more growth in the irrigated plots.

There was a trend for the thinning of tree stand to increase yield of nuts and tree growth, but the differences were not significant. This experiment was started in 1951 and the seasons since then have been unduly dry, but the season of 1953 is the first one in which irrigation has substantially increased the yield and quality of the nuts produced.

The spraying of pecan trees in Georgia over a long period of years with bordeaux mixture for the control of pecan scab has resulted in the accumulation of such large amounts of copper in the soil as to prevent satisfactory growth of winter legumes such as crimson clover, hairy vetch and Austrian peas. Rather heavy applications of dolomitic limestone and superphosphate to such soils have effectively counteracted the toxic effects of the accumulated copper.

So far, in all producing areas, nitrogen is the only major element applied as a fertilizer in a number of factorial experiments which has shown effects on the performance of pecan trees consistent enough to be considered as effects of the treatments. In all cases nitrogen applications increased the growth of trees and yield of nuts, and in most cases the increases have been statistically significant and of high practical value. Unless applied at very high levels nitrogen applications have had no detrimental effects on filling of the nuts. In no case have there been any consistent and significant main effects of phosphorus, potassium, calcium or magnesium when applied singly or in combination to the soil at fairly high levels, on the composition of the leaves, growth of the trees, yield, size or quality of the nuts produced.

In Louisiana in 1953 spray application made shortly after full bloom of maleic hydrazide at concentrations of .05 percent and higher thinned the set of nuts very significantly. However, the trees sprayed with this chemical in 1953 did not set a normal size of crop in 1954. Therefore, it now seems that maleic hydrazide cannot be used in pecan nut thinning because of the adverse residual effects.

In 1954, tests were made with 2,4,5-T and 3-chloro-isopropyl-N-phenyl carbamate at various concentrations and times of application. Some significant thinning of the nut crops resulted. This work will be continued.

Walnuts - In Oregon six pounds of actual nitrogen per tree increased the per-tree yield by approximately 40 pounds of nuts in 1953. No other element or combination of elements used in experiments had any significant effect upon yield. None of the elements, other than nitrogen, used either alone or in combination had any significant effect upon the size of the nuts or the percentage of kernel or the degree of filling.

Irrigation of walnut orchards increased the average yield by 32 pounds per tree. In this particular experiment both irrigated and non-irrigated trees received identical fertilizer treatments. Irrigation increased the size of nuts produced and reduced the amount of shrivel in walnuts by 8 percent.

In cooperation with Oregon Agricultural Experiment Station, a study of rootstocks for Persian walnuts has been started. This work looks forward to finding a suitable stock that will prevent the development of blackline.

Filberts - In Oregon, heavy nitrogen applications to filbert trees has significantly increased the yield of nuts and reduced the percentage of blank nuts. No other element applied singly or in combination has had significant effects on tree growth or yield.

Chestnuts - Highly significant differences in tree growth, yield and in size of nuts produced have resulted from nitrogen and magnesium applications to Chinese chestnut trees growing on a Sassafras sandy loam soil at Beltsville, Md.

The superior performance of grafted Chinese chestnut trees over seedling trees was fully demonstrated in 1954 in a number of orchards.

Plan - Present long-time experiment to be continued as now set up. Work on the use of chemicals for the thinning of nut crops to prevent over production is to be continued and expanded. New work to determine why such elements as phosphorus, potassium, calcium and magnesium are apparently not absorbed, or if so why they do not accumulate in the leaves of walnut and pecan trees is planned.

Publications

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EQUIPMENT FOR APPLICATION OF INSECTICIDES AND FUNGICIDES -AE

Progress and Findings - 1954 Recommendations "Expand research on the development of improved equipment for the control of insect pests and plant diseases to include work on special equipment for deciduous fruit and tree nut crops." (17/18)

Expansion of work pertaining to special equipment for the control of insect pests and plant diseases in deciduous fruit and tree nut crops was not possible. However, the findings of research which may be somewhat applicable are reported below.

The study of the effect of pesticides on application equipment in cooperation with industry groups was continued. Two general lines of approach to the problem were undertaken: Investigation of protective coatings for tanks and investigation of construction materials for greater corrosion resistance. A correlation of all data presently available on the resistance of coatings has shown that out of the vast varieties of coatings, only a few have shown acceptable resistance to a majority of the pesticides. For a study of construction materials, cooperation was secured with a leading manufacturer of alloys in conducting spool type specimen tests under actual field conditions. Of the 17 different alloys tested under a wide variety of pesticide and operating-conditions exposure, certain over-all observations are apparent: 1. The stainless steel (types 304, 316) and Monel were highly corrosion resistant in all of the tests. 2. Nickel and aluminum showed slight tendencies toward pitting in a few of the tests. 3. The low alloy steels did not appear to offer any significant improvement over carbon steel. 4. In most cases, zinc showed a sufficiently high corrosion rate to indicate that galvanized sheet would lose its zinc coating in a year or less. 5. Ni-Resist, phosphor bronze, and 85-5-5-5 bronze showed reasonable good corrosion resistance and were consistently several times better than cast iron.

In the fundamental studies of spray atomization and nozzle patterns progress has been made in the techniques and instrumentation so as to greatly speed up the drop counting procedure. Tests of drop size ranges have been completed for a flat fan pattern type nozzle of various capacities, for similar nozzles of different angular pattern spread and with pressures varying from 40 to 250 p.s.i.

In cooperation with the Division of Forest Insect Research, Forest Service (formerly Bureau of EPQ), a series of airplane spray tests was made over open ground with a Stearman plane to compare the spray distribution from various arrangements of nozzles on the spray boom. At heights of 50 feet there was no practical difference in spray distribution whether the nozzles were placed along the full wing span or along only the inboard half of the boom, and either location provided efficient distribution.

In airplane spraying tests made in cooperation with the Entomology Research Branch for pea aphid control, it was found that unpredictable and erratic deposit rates may be minimized, and maximum swath-widths produced by use of finely atomized sprays inboard and medium to coarse sprays outboard. Excellent and recommendable nozzle arrangements for use on bi-planes of the N3N and Stearman class have been worked out and effectively employed for control of the pea aphid. Effective swath-widths of 55 feet for flight-levels of 1 to 2 feet; 58 feet for 4- to 5-foot flight-levels; and 65 feet for 7- to 8-foot flight levels were obtained.

Plans - Work will continue along same lines.

- N. Proposal for Committee Consideration - Expand research on the development of improved equipment for the control of insect pests and plant diseases to include work on special equipment for deciduous fruit and tree nut crops.

Publications

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Spray distribution studies at low flight-levels, by V. D. Young. Published in the Proceedings of Fifth Annual Meeting of Washington State Weed Association, October, 1953.

Report of findings relating to control of the pea aphid in the Blue Mountain Area (1953), by W. C. Cook, V. D. Young, J. C. Chamberlin, Ralf Schopp, Paul M. Eide, and F. P. McWhorter. Mimeographed report to the Pea Aphid Research Committee of the Northwest Cannery Association.

A study of the spray deposit from a U. S. Air Force C-47 equipped with spray booms, by D. A. Isler, J. M. Davis, and D. G. Thornton. Special Report BV 53-3, mimeographed, to inform cooperators of results of tests. May 6, 1953 - restricted distribution.

INSECTICIDE RESIDUES ON CROPS AND ON FLAVOR - ENT, HN, WU

The production of marketable vegetables, fruit and other agricultural products is dependent upon the judicious use of a variety of insecticides. The insecticidal residues and the effects on quality and flavor resulting from the use of insecticides bring forth new problems each year and research investigations are undertaken to solve them as

a part of the overall program to develop safe and effective chemicals for controlling insects affecting plants and animals. Many insects become increasingly tolerant or resistant to insecticides which aggravates the problem. The main objective is to obtain commercial control of economically important insects without leaving injurious residues or adversely affecting the quality or flavor of crops or products derived from crops. In appraising the significance of residues found in food products it is necessary to take into account official or unofficial tolerances established by such regulatory agencies as the Food and Drug Administration. Residues as high as 5 ppm (parts per million) might not be considered excessive for one insecticide; for a particular food item, whereas levels above 0.1 ppm might be regarded excessive for another insecticide.

Deciduous Fruits and Grapes: Tests of insecticides on apples and peaches, including parathion, malathion, methoxychlor, Aramite, EPN, dieldrin, aldrin, heptachlor, Chlorothion, Diazinon, and CS-728, resulted in good control of pests without affecting adversely the quality and flavor of the fruit and without leaving excessive residues on the harvested crop. In Ohio a combination spray of parathion and bordeaux mixture not only gave better control of the two-spotted spider mite on grapes than one of malathion and bordeaux mixture but also resulted in a significantly higher sugar content of the fruit. On grapes, too, excellent control of the leaf form of grape phylloxera was obtained with lindane without evidence of any off-flavor of the fruit.

Developments in the timing of spray applications and in the manner of application that will tend to result in lower harvest residues were also promising. In New Jersey early season applications of parathion and EPN gave effective, all-season control of the oriental fruit moth, obviating the need for applications close to harvest. In Georgia field tests of soil applications of aldrin and dieldrin for plum curculio control on peaches were initiated in the hope that the need for direct application of sprays to the trees and fruit may be curtailed. These insecticides gave a high degree of control in preliminary laboratory tests. In Washington, further preliminary tests of soil insecticides indicated that cherry fruit fly emergence can be prevented by soil applications of chlordane, aldrin, dieldrin, endrin, BHC, malathion, heptachlor and isodrin. Colonization of oriental fruit fly parasites in cherry areas in the Pacific Northwest to reduce cherry fruit fly infestations and avoid full coverage sprays has not given encouraging results.

Plans - A broad program of research will be continued and strengthened whenever possible to develop spray programs that will control destructive pests of fruits, vegetables, grains, forage and other crops without adversely affecting their flavor and quality or contaminating them with harmful residues. The effects of the newer insecticides on soils and plants when used on crops under a variety of conditions, their effects on quality and flavor, and the quantitative determination of insecticide residues remaining on different crops following periodic applications during the development of these crops will be undertaken whenever possible. Special attention will be given to the determination of residues resulting from the use of systemic insecticides. The above studies are required before potentially useful pesticides can be recommended for use on food crops consumed by man or animals.

Publications

Persistence of BHC, DDT and toxaphene in soil and the tolerances of certain crops to their residues. Norman Allen, R. L. Wallis, L. C. Fife, R. D. Chisholm, Louis Koblitsky, J. F. Bullock, C. R. Hodge and E. E. Hall. U.S.D.A. Tech. Bul. 1090. 1954.

The effects of continued widespread use of organic insecticides (3). Effects on plants and soil. D. W. Hamilton, Proc. Ind. Acad. Sci. 63: 190-194. 1953.

Spray residues on grapes and their occurrence in wines. G. W. Still. Jour. Econ. Ent. (in press)

RESIDUES OF PESTICIDES IN SOILS AND PLANTS - HC

A technical manuscript reporting the results of four years work on plant responses to single doses of DDT, BHC and chlordane in soils in four states has been submitted for publication. The results have been briefly presented in earlier progress reports to advisory committees.

Studies of accumulation of chlorinated hydrocarbon insecticides in soils following heavy spray applications to crop foliage were continued in five states. Data on tendency to accumulate as residues in the soil tended to confirm results reported earlier. Of nine substances used only BHC residues appeared to affect quality and flavor of crop markedly and none significantly impaired yield. Chemical analyses are incomplete.

Larger numbers of crop samples than previously are being analyzed by the Entomology Research Branch but data are not available in time for this report.

Publications

A publication on the studies of residues from spray application is to be prepared within the year. The sudden death of A. C. Foster has unavoidably interfered with the progress of this work in the Vegetable Crops Section.

0. Proposal for Committee Consideration - Pesticide Residues - Expand work on insecticide, fungicide and herbicide residues, including their toxicological effects. The lack of information on the extent to which residues occur in soils and in foods consumed by man and animals following the use of pesticides continues to be a major obstacle to the maximum utilization of the new pesticide chemicals in the protection of crops and animals. Although increased appropriations for FY 1955 permitted some expansion of research on insecticide residues the extent of such expansion is inadequate. There is need for further expansion of research on the effects of various new pesticides on plants and soils, the determination of residues in soils and in and on plants and animals following use, including systemic insecticides and their degradation products, and on the evaluation of the effect of pesticides on the quality or flavor of foods.

HARVESTING PRACTICES, MATERIALS AND EQUIPMENT

MECHANICAL AIDS IN HARVESTING FRUITS - AE

Progress and Findings - 1954 Recommendations "Expand studies of mechanical aids and devices for increasing labor efficiency in harvesting fruits."
(16/18)

The fiscal year 1955 appropriations provided additional funds for fruit harvesting studies. These funds are being used to initiate a new project on the engineering phases of the production and harvesting of tree fruits with particular emphasis on apple harvesting research at Wenatchee, Washington, and to expand the fruit harvesting and farm handling research at Michigan. In both cases the work is in cooperation with the State Agricultural Experiment Station. Personnel from the Washington project reported in October in time to make preliminary studies of the apple harvesting problems during the 1954 season.

Handling Cherries in Water - During the 1953 cherry harvest, methods and equipment were developed for transporting cherries in tanks containing water from receiving stations to processing plants - distances varying from 25 to 250 miles. Over 400,000 pounds of sour cherries were moved successfully under the direction of the researchers and data accumulated showed that this method resulted in better quality and lower costs of handling.

For the 1954 harvest, methods and equipment were developed for transporting sour cherries in water directly from the orchard to the processing plants. During the harvest 304,600 pounds of cherries were moved experimentally from the tree into the cannery without the use of a single lug. In addition approximately 5,000,000 pounds were moved in water commercially during the 1954 season mostly from orchard concentration points to canneries. One of the largest Michigan cherry processing plants (10 to 12 million pounds per year) has announced that cherries from their receiving stations and from many of their larger growers will be handled in water in 1955.

Orchard Handling and Packing Blueberries - The production of cultivated blueberries is a recent development. From about 1938 to 1953 the value of this crop in Michigan increased from zero to approximately \$2,600,000 and the indications are that production will continue to increase to perhaps \$5,000,000 within the next few years. Research so far has dealt largely with varieties and cultural practices for high yields and good quality. Little, if any, research work has been directed towards the development of farm handling and packaging methods and equipment for reducing labor requirements and in maintaining high quality.

In 1954 an engineering analysis of handling and packing blueberries by present conventional methods was made. Procedures and equipment for a new method of orchard handling and packing were developed and given preliminary tests. Approximately 75,000 lbs. of blueberries were handled by the new system and results look promising.

Apple Harvesting - The engineering phases of apple harvesting are to be a major activity of both the Washington and Michigan projects. Since the Washington project was only initiated in October, 1954, no results or findings were available when this project report was prepared.

At the Michigan project during the 1954 season, additional time studies on the harvesting of apples were made. The project personnel also spent considerable time in first hand field studies of the physical details of all phases of apple harvesting and orchard handling. As a result of these field studies, a number of experimental changes in apple harvesting procedures are being planned for exploratory trials during the 1955 season.

Plans - Work will continue along the same line with particular emphasis on orchard handling of blueberries in Michigan and apple harvesting research in Washington.

Publications -

On The Farm Refrigerated Fruit Storage. H. P. Gaston and J. H. Levin, Special Bulletin 389, Michigan Agricultural Experiment Station, January, 1954.

From Orchard to Cannery - Under Water. J. H. Levin and H. P. Gaston, Reprint from "Food Engineering", pp. 58, 59 & 153, January, 1954.

Hydracooling and Transporting Red Cherries in Water. J. H. Levin and H. P. Gaston, A Progress Report, reprinted from the Quarterly Michigan Agricultural Experiment Station Bulletin, Vol. 36, No. 4, pp. 378-385, May, 1954.

Michigan Apple Storage Facilities. B. C. French, J. H. Levin and H. P. Gaston, reprinted from the Quarterly Michigan Agricultural Experiment Station Bulletin, Vol. 36, No. 4, pp. 408 - 414, May, 1954.

Storage Holdings and Movement of Apples in Michigan and the United States. B. C. French, J. H. Levin and H. P. Gaston, reprinted from the Quarterly Michigan Agricultural Experiment Station Bulletin, Vol. 36, No. 4, pp. 415 - 425, May, 1954.

B. Proposals for Committee Consideration

PRODUCTION RESEARCH

	<u>Page No.</u>
A. Expand breeding on stone fruit, strawberries, grapes, Chinese chestnuts and almonds, including nematode-resistant peach stocks.	11
B. Expand research on powdery mildew of apple.	15
C. Expand research on virus diseases of fruits.	19
D. Expand work on the relationship of insects to the numerous viruses of tree, bush and small fruits.	25
E. Expand studies of insect resistance to insecticides.	29
F. Expand work on systemic insecticides for use to control pests of tree fruits and nuts, small fruits and berries.	29
G. Expand research on the development of methods for controlling mites on strawberries.	31
H. Expand studies of the grape phylloxera to include control of the root-infesting form on both western and eastern type grapes.	36
I. Expand work on soil moisture and irrigation and their effect on size, finish, regularity of bearing and other factors in apples and peaches.	40
J. Expand work on basic nutrition of fruit trees, particularly in evaluating leaf analyses as a guide to fruit tree fertilization.	40
K. Expand work on chemical thinning of fruits.	41
L. Expand work on planting old fruit tree sites.	44
M. Expand research on weed control of small fruits, particularly strawberries and grapes.	45
N. Expand research on the development of improved equipment for the control of insect pests and plant diseases to include work on special equipment for deciduous fruit and tree nut crops.	50
O. Expand work on insecticide, fungicide and herbicide residues, including their toxicological effects.	53

II. UTILIZATION RESEARCH

A. Progress on Work Under Way

CONSUMPTION AND HUMAN NUTRITION

FAMILY FOOD CONSUMPTION AND DIETARY LEVELS - HN and HE

Progress and Findings - Tabulation and analysis of the survey of food consumption of rural families in the North Central region has continued and publications are being prepared. Some data on family food expenditures, the money value of home-produced food, the quantities of home canned and home frozen foods, and the nutritive adequacy of the diets have been included in the 1955 Outlook Charts. Average expenditures for food indicate that in this region the market for food sales to farm families is about three-fourths as large per family as that to rural nonfarm and city families. The diets of the farm families, however, were better than those of the rural nonfarm families due in part to large supplies of home-produced foods.

At least a fifth of the rural nonfarm families had diets that furnished less than recommended amounts of the 5 vitamins studied, a third, with respect to calcium. This indicates that a large potential market exists among rural nonfarm families for those fruits and vegetables that furnish vitamins A and C, for those grains, meats, and other foods that are good sources of the B-vitamins, and for milk, the principal source of calcium.

Plans - Plans for the future involve further analysis and publication of data from the survey (contract) of food consumption of North Central rural families.

Because no recent nationwide survey of food consumption and dietary levels has been made, plans have been made for a large-scale survey in the spring of 1955 (contract, cooperative with AMS). Such a survey will be large enough to provide regional data and separate averages for farm, rural nonfarm and urban groups. Because of current agricultural surpluses, analyses to locate underconsuming groups on a regional basis and to determine what shortages exist are especially timely. Surveys of the consumption of all foods families eat are needed to determine a) the nutritive value of diets, b) the importance of individual foods in the total food budget, and c) the interrelationships in the consumption of commodities.

food consumption

- A. Proposal for Committee Consideration - Expand analyses of the/survey data collected in 1955 to show (1) interrelationships among nutrients and dietary patterns, (2) the relative economy of foods in the light of present-day prices, consumption, and marketing practices, and (3) changes in the income-consumption relationships for foods since 1948. Such analyses cannot be made with existing staff and cannot be advantageously made under contract. (The survey data are to be collected and tabulated under contract. Present staff is fully occupied planning, supervising, and preparing descriptive reports of the data.)

Publications

Agriculture Outlook Charts, 1955. (Three charts on food consumption and dietary levels.) October 1954.

Food Consumption of Farm Families, Meeker and Wright Counties, Minnesota, 1950. F. Clark and C. LeBovit, U.S.D.A. AIB-127. 1954.

Food Consumption of Urban Families in the United States with an Appraisal of Methods of Analysis. F. Clark, J. Murray, G. S. Weiss, and E. Grossman, U.S.D.A. AIB-132. 1954.

NUTRITIONAL QUALITY OF PER CAPITA FOOD SUPPLY - HN

Progress and Findings. As one indication of how well our national food supply provides for the nutritional needs of the population, the nutritive content of the per capita food supply is computed at least once a year, permitting analysis of trends since 1909. A revision of this series recently published shows average values for calories, and 11 nutrients, as well as the proportion of each nutrient furnished by each of 12 food groups. Average values for several nutrients were somewhat lower in 1953 than in the peak years of 1945-46; ascorbic acid was down 15 percent and vitamin A, 18 percent, associated with smaller consumption of fruits and vegetables. The average amount of folic acid, one of the B-vitamins only recently included in the calculations, ranged from 0.120 mg. to 0.151 mg. per person per day over the 43 year period. How well these levels meet human requirements is not known at present. Leafy, green and yellow vegetables furnished a fourth of the total folic acid, other vegetables and fruit, 10 percent; potatoes and sweetpotatoes, 5 percent and citrus and tomatoes, 5 percent.

Plans - Computations of the nutritive value of the food supply will be continued as a basis for studying trends.

HUMAN REQUIREMENTS, DIETS AND PHYSIOLOGICAL AVAILABILITY OF NUTRIENTS - HN

Progress and Findings - Work has continued under contract to determine the energy requirements of young women (20-30) and of older women (50-60) engaged in the same selected physical activities; thiamine and riboflavin requirements of college women and women over 50 under similar dietary conditions; amino acid requirements of women; fatty acid requirements of infants and children; thiamine and riboflavin requirements of adolescent boys. Also continuing are studies in rats of the effect of type of carbohydrate on amino acid requirement and cooperative studies of diets of older men in relation to their physical state. Results of studies of the physiological availability of ascorbic acid have been evaluated and are being prepared for publication. Just initiated under contract is a study of the availability of amino acids from selected foods.

Plans - A bulletin will be published presenting the results of research on the development and application of a standardized diet for use in determining requirements and physiological availability of nutrients. New research is needed along several lines. See proposals.

Proposals for Committee Consideration -

- B. Initiate long-term studies of diet and nutritional status of adult men and women considered to be in excellent physical state. The studies should include healthy individuals in each decade from 20 to 70 years. Periodic appraisals of diet and of physical and nutritional status using appropriate biochemical, physical and other criteria would be made to discover trends in food consumption and physiologic utilization of nutrients, trends in various biochemical, physiologic and metabolic criteria which change with age, and if possible, the relation of these changes to diet, environment and health history.
- C. Expand research to obtain needed data on availability to the human body of important nutrients in foods, such as amino acids from various food sources. Because certain nutrients may be present in food but not utilized by the body, data on food composition need to be supplemented with information on the physiological availability of the nutrients. The research should include studies of factors in composition of the food and the diet, and in metabolism, which affect availability of nutrients from foods. Such fundamental information, based on studies of human subjects, is needed for realistic appraisal of the nutritive value of foods and of dietary practices, and in planning for improved nutrition in all age groups.

- D. Initiate studies to determine how health and well being of human subjects are influenced by the level of fat in the diet. These investigations should include the following: (1) the kinds, amounts, and proportions of fat desirable in the diets of children, mature adults, and aging people; (2) dietary precautions needed when fat is unusually low or high in diets; (3) the effect of the quantity of fat in the diet on the digestibility and utilization of other nutrients. A perennial question facing research workers and raised repeatedly by Advisory Committees is how much fat is desirable in human diets, and how much fatness is wanted in foods as they reach the market and the table. The National Research Council stated some years ago that about 25 percent of the calories in a normal diet should be from fats. Countries under economic stress around the world have levels below 20 percent, the present level in the USA is about 40 percent. When all sources are considered, fat in our food supply amounts to about 115 pounds per capita per year. What proportion of this disappears as waste in food processing or on the plate is not known.

A limited amount of added fat in feed favors growth of farm animals and results in production economies. On the other hand, studies of aging persons and experimental animals on abundant diets over their entire life span have implicated high-fat, high calorie diets in some disorders of metabolism. The role of fat in certain degenerative diseases is still controversial; however, basic information is essential to answer the question as to whether fat alone, specific fats or fatty acids, or an imbalance of nutrients are responsible for the metabolic disorders observed and to determine the possibility of their prevention by dietary means.

Publications

Tables page 3, 37 and 38 in National Food Situation, USDA, August 1954. (Supplement to Consumption of Food in the U. S. 1909-52, Agr. Handbook 62, Nov. 1953.)

"Essential Fatty Acids and Human Nutrition. I. Serum Level for Unsaturated Fatty Acids in Healthy Children." Hilda F. Wiese, Reagan H. Gibbs, and Arild E. Hansen. Jour. of Nutr. 52, No. 3, March 10, 1954. pp. 355-366.

"Essential Fatty Acids and Human Nutrition. II. Serum Level for Unsaturated Fatty Acids in Poorly Nourished Infants and Children." Arild E. Hansen and Hilda F. Wiese. Jour. of Nutr. 52, No. 3, Mar. 10, 1954, pp. 367-374.

"Sequence of Histological Changes in Skin of Dogs in Relation to Dietary Fat." Arild E. Hansen, John G. Sinclair, and Hilda F. Wiese, Jour. of Nutr. 52, No. 4, April 1954, pp. 541-554

"Influence of Carbohydrate, Nitrogen Source and Prior State of Nutrition on Nitrogen Balance and Liver Composition in the Adult Rat." M. W. Marshall and M. Womack. Jour. of Nutr. 52, 51-64, 1954

"Food Habits of Iowa School Children -- Breakfast." V. D. Sidwell and E. S. Eppright. Jour. Home Ec. 45: 401-405, 1953

"Relationships of Nutrient Levels of Diets of Iowa School Children to Physical and Biochemical Measurements." Ercel S. Eppright, V. D. Sidwell, and C. Roderuck. Abstract in Fed. Proc. 13: 456, 1954

"Nutritional Status of the Aging. I. Hematology of 577 Normal Men and Women Over 50 Years of Age." H. L. Gillum and A. F. Morgan, Abstract in Fed. Proc. 13: 469, 1954

YIELDS AND LOSSES FROM DIFFERENT MARKET QUALITIES OR PREPARATION METHODS - HN

Progress and Findings - 1954 Recommendation, "Initiate studies of a laboratory nature to determine the losses and obtainable yields from deciduous fruits of different market qualities and from common methods of preparation and handling in the kitchen." (12/12)*

No new funds were available for initiating a major attack on the problem of yields and losses. Work has continued, however, on collecting available laboratory data obtained during studies of food preparation, quality or nutritive value. In addition, studies of losses and yields from selected fruits, vegetables and meats in the regular food service of two hospitals and two colleges have been initiated under contract.

Considerable variability is found in the cooked or edible yield of many foods. For example, among fresh fruits used in the laboratories, yields of raw prepared apples ranged from 62 to 95% of the original purchase weight, with losses due to removal of peels, cores, and bad spots. Yields of avocados from 3 dissimilar projects were around 70% when seeds and peels were removed. Bananas yielded 58% of the purchase weight after removal of peels and bad spots. Blackberries had yields of 93 to 100%; blueberries, 94%; cherries, 78%; cranberries, 93 to 98%, and raspberries, 99%, the yield for strawberries varied from 60% to 94% depending on the quality of the berries. The yield of cantaloupe ranged from 45 to 66% of purchase weight after rinds and seeds were discarded, honeydew melon, 65 to 73%; and watermelon, 44 to 56%. Yields of Elberta peaches ranged from 54 to 85%; bartlett pears, 80 to 90%; pineapple, 40%; and plums, 92 to 96%.

* 12/12 Means twelfth in priority of twelve recommendations of 1954 in Utilization Research.

Among the dried fruits, cooked dried apricots (4 lots tenderized and one bulk sample) showed gains in drained weight over purchase weight ranging from 74% to 114%; three lots of tenderized peaches 72% to 99%; two lots of bulk dried pears, 56% to 115%; and four lots of prunes, 44% to 58%. In practically all cases the yield of drained solids was higher if the fruit was left standing in the liquid after cooking. One sample of prunes, yielded 121% cooked edible solids after cooking, seeding and chopping.

The yields of edible nut meats as percentage of purchase weight in the shell were as follows: chestnut, 82; soft shell almonds, 5; pecans, 51; English walnuts, 46; Brazil nuts, 41; and filberts, 35. In an insecticide study on filberts, quality was highly variable, yields of 24 lots ranging from 16% to 40%.

These new data will be incorporated with any data available from other sources in drafting tables of yields and losses. Such tables will provide not only an "average" figure for yield but also the range or some other indication of variability.

Plans - During this fiscal year, the limited yield data available will be used to develop a guide for school lunch managers on quantities to buy for serving school lunches and also to do as many laboratory studies as possible to get urgently needed data on frozen foods, including fruits.

- E. Proposal For Committee Consideration - Expand laboratory work and studies of "in practice" situation to determine losses and usable yields from deciduous fruits of different market quality, fresh and frozen, and from common methods of handling in the kitchen. The guide for school lunches to be drafted this year will be based on very scanty data on many foods, including fruits. Systematic research to fill the many gaps in available data must be accelerated in order to provide home and institutional buyers with adequate guides to quantities to purchase in order to provide nutritionally adequate and appetizing meals with a minimum of waste. Such data will also be useful to producers and distributors in indicating the variability in quality and yield of many commodities and thus providing a basis for prevention of unnecessary waste or spoilage in production and marketing.

SURVEY OF FOOD AND NUTRITION RESEARCH - HN-DU

Progress and Findings - To aid research leaders in universities, industry, and government to prevent duplication of effort, a survey on the nature and amount of food and nutrition research under way in this country during

1952-53 was completed under contract by the National Academy of Science. The report records research under way by some 440 organizations. It includes research in foods, food technology, physiological and biochemical aspects of nutrition, nutrition in disease, the nutritive value of food and feed and nutritional requirements of man and beast. Many of these researches deal specifically with deciduous fruits and tree nuts. For example, in the section on Food Technology, there are listed almost 70 projects and in the section on Food Composition, more than 20 projects dealing with deciduous fruits and tree nuts. Also included in the report are some 250 suggestions for research of immediate urgency.

Plans - This project has been completed.

Publications

Survey of Food and Nutrition Research in the United States of America 1952-53. U. S. Department of Agriculture, April 1954.

COMPOSITION, QUALITY EVALUATION AND PRESERVATION

PECTIC CONSTITUENTS IN GREEN AND RIPE FRUITS - WU

Progress and Findings - 1954 Recommendation "Expand research on the kind and quantities of constituents of fruits and nuts, utilizing the newer scientific techniques, for the purpose of appraising flavor, color and texture of the raw material and final product." (1/12)

Resources available did not permit expansion at the Western Utilization Research Branch; at the Eastern Utilization Research Branch, research on the constituents of apples and sour cherries was expanded.

A study of the pectic substances and the pectic enzymes in ripe and unripe fruits has been made at the Western Utilization Research Branch. Ripe and unripe Elberta peaches, Bartlett pears, and Fuerte avocados were analyzed and their pectic substances extracted and characterized. From these results it was concluded that the enzyme polygalacturonase, which degrades pectic substances to materials of low molecular weight, seems to develop during ripening. No polygalacturonase was demonstrated in any of the green fruits tested. Upon ripening, however, polygalacturonase activity could be demonstrated in the pears and avocados. From

the characteristics of the pectic substances isolated from fruits of both stages of maturity, it was concluded that upon ripening, the enzyme pectinesterase had attacked the pectic substances of these fruits and partially converted them to pectic acids. This action combined with the action of the polygalacturonase enzyme is sufficient to explain softening of fruits during ripening. It is not yet resolved whether softening of the fruit is a result of ripening and the action of pectic enzymes is a secondary factor, or whether the action of pectic enzymes themselves is primary cause of softening during ripening of fruits.

Plans - Studies of factors affecting the texture of fruits and fruit products will be continued.

VOLATILE FLAVOR CONSTITUENTS OF STRAWBERRIES - WU

Progress and Findings - Studies on the volatile flavor constituents of strawberries have been continued at WURB, to aid in development of improved methods for flavor recovery and to develop chemical methods suitable for flavor analysis. As mentioned previously, 33 grams of an aromatic oil was recovered from the distillates from 44,000 pounds of strawberries at a commercial preserve manufacturing plant. This oil, light yellow in color, contained about twenty percent of mixed organic acids which have been identified as acetic, butyric, valeric, and caproic acids. These acids, although strong in odor when concentrated, have been shown not to contribute to the flavor in the dilutions in which they are found in single-strength juice. The oil freed of these acids has been studied further. One type of measurement (optical rotation equal to zero) indicated that most terpene-like materials are absent. Most of the oil is apparently a mixture of esters. One organic acid isolated from these esters is thought to be, from chemical studies, a nine-carbon dicarboxylic acid.

Plans - Further work is being done to characterize the constituents of this aromatic oil.

SUBSTANCES CONTRIBUTING TO THE CONSISTENCY OF FRUIT PUREES - WU

Progress and Findings - This work has been continued at the Western Regional Research Laboratory with particular emphasis on investigating the relation of water-insoluble solids content to consistency, and the influence of pectin and salts and acids of the types occurring naturally. As shown

previously, consistency will vary directly with the amount of water-insoluble solids in any given preparation. When water-insoluble solids were isolated, by washing exhaustively with hot water, then resuspended in water or 10% sucrose solution, the consistency at a given level of these solids was greater than in the original puree with the same insoluble solids content. When the sucrose-water suspensions of insoluble solids contained citric acid-sodium citrate mixture, at acidity and pH levels found in the puree, there was a marked thinning. When citrus pectin was added to either the sucrose-water or sucrose-citrate suspensions, the suspensions were thinner than those in sucrose-water alone, but thicker than those in sucrose-citrate solutions.

Microscopic studies have been undertaken in connection with investigations on the water-insoluble solids of fruit purees. The water-insoluble solids of apricot puree consist principally of tissue fragments (including insoluble cellular contents). These fragments were classified as: (1) whole, intact, separated flesh (parenchyma) cells both spherical and oblong in shape, (2) clusters of intact, unseparated flesh cells, (3) broken cells (i.e., cell wall fragments), (4) vascular or conducting tissue strands, including attached cells ("rag"), (5) skin tissue fragments ("rag"). Microscopic methods have been developed for characterizing these fragments by measuring their size and shape and determining their percentage distributions in different purees. These methods provide means of obtaining samples of the insoluble solids for studies on density, sedimentation rates, etc., and on the influence of the different particles on puree consistency.

Plans - Further work is planned to determine effects of other acids and salts which occur in the purees on the consistency, and to define more clearly the role of pectin. The chemical constitution of the insoluble solids is also considered for future work. Microscopic studies will be continued and it is contemplated that work can be extended to include histochemical investigations of these tissue particles.

PECTIN CONSTITUENT OF BRINED CHERRIES - WU

Progress and Findings - Although the practice of brining cherries for manufacture into maraschino cherries is simple and straightforward, the firming of the texture by this procedure is not completely understood. Occasionally, a lot of stored brined cherries is lost through softening. Pectic substances have been found to play an important role in the maintenance of texture of other fruits and it was believed that changes in pectic substances might explain the firming reaction as well as the reason for deterioration in brined cherries. Samples of brined cherries, both firm and soft in texture, as well as the corresponding brines were analyzed.

The pectic substances were extracted, isolated, and characterized from both types of cherries. The characteristics of the pectic substances suggested that firming of cherries takes place by two reactions. The pectinesterase enzyme naturally present in cherries (as well as all other fruit) first converts the pectin to pectic acid. The calcium present in the brining solution then reacts with the pectate of the cherries to form a firm gel-like structure within the fruit. It appears that softened cherries are the result of a contaminating enzyme polygalacturonase which degrades pectic substances to materials which cannot react with calcium and produce firm calcium pectate gels. It also appears that the contaminating enzyme source could be from molds or yeasts growing on the cherries between harvesting and brining or could be introduced into the brine from residues within the barrels or tanks.

Plans - No further work on pectic substances of brined cherries is contemplated. Results obtained in the studies will be published in the coming year.

CONSTITUENTS OF SOUR CHERRY PACKS - EU

Progress and Findings - Previous studies have shown that some cherries subjected to a mild bruising and aging treatment prior to canning gave a product with improved texture and drained weight. A study was undertaken to determine if this change was related to any differences in composition.

Results based on samples processed during the 1953 season indicate that pectin is not a factor in the increased firmness and higher drained weight of bruised and aged cherries. In fact, pectin decreased in proportion to the severity of the bruising and aging treatment. Analyses of the insoluble solids, other than pectin, indicated an increase of approximately 12 to 20 percent in the lignin, cellulose, and hemicellulose fractions.

Plans - These studies will be expanded in an effort to gain a better understanding of the relationship between post harvest changes in sour cherries and the yield and quality of the processed fruit.

Publications

Fermate Residues on Canned Montmorency Cherries, C. H. Hills, E. J. Calesnick, E. C. Dryden, and M. S. Gaspar, Proc. Am. Soc. Hort. Sci., 62, 261-6 (1953).

ORGANIC ACIDS IN APPLE JUICE AND APPLE JUICE CONCENTRATES - EU

Progress and Findings - This investigation was undertaken to obtain more complete information on the organic acid composition of apple juice and apple juice concentrates with the ultimate objective of determining the influence of these constituents on the stability of the stored concentrates. Paper chromatographic analysis of the organic acids in fresh juices and in stored darkened concentrates indicated that the differences were only of a slight quantitative nature. The juices and concentrates apparently contained the acids reported as fresh fruit constituents; i.e., malic, citric, quinic, succinic, chlorogenic, caffeic, and phosphoric. Galacturonic and lactic acid were also present. In addition, indications were noted of the presence of five other unidentified acids.

Plans - This study is being continued with particular emphasis on the identification of the unknown acids.

NEW METHODS FOR DETERMINING ALDEHYDE GROUPS IN FRUIT CARBOHYDRATES - WU

Progress and Findings - Certain types of food spoilage have been correlated with the presence of aldose-type sugars such as glucose. Present methods for determining aldoses require alkaline media. However, it is becoming known that important types of carbohydrates undergo complex side-reactions in alkaline media, giving rise to grossly incorrect values.

To avoid these difficulties a method employing the recent commercially available chlorous acid has been developed at the Western Regional Research Laboratory. In the weak acid medium troublesome side-reactions do not occur, and experiments with known pure aldehyde-containing sugars have yielded quantitative results. Furthermore, alkali-sensitive materials yield definite, reproducible values under those analytical conditions which give faulty values using alkaline methods. The method shows precision down to a few millionths of a gram. Results so far indicate that the new method provides a new, more reliable tool for the study of carbohydrates, giving a clearer understanding of the role of fruit constituents in spoilage.

Plans - It is planned to continue research on oxystarches, pectins, oxydextrins, and other alkali-sensitive materials.

Publications -

"Reaction between chlorous acid and glucose. Quantitative stoichiometry and evaluation of reagent decomposition." H. F. Launer and Y. Tomimatsu, Anal. Chem. 26, 382 (1954).

"Kinetics of the chlorite-glucose reaction. H. F. Launer and Y. Tomimatsu, J.A.C.S. 76, 2591 (1954).

- F. Proposals for Committee Consideration - Expand research on the kind and quantities of constituents of fruits and nuts, utilizing the newer scientific techniques, for the purpose of appraising flavor, color and texture of the raw material and final product. This should include studies on the isolation and determination of the chemical and physical properties of non-starch carbohydrate fruit polymers in order to provide information regarding their influence on the texture of fruits and their processed products and on the biological structure, microscopic and submicroscopic, of the plant tissue. New scientific techniques, such as in the field of chromatography, make possible researches on composition that hitherto have been extremely difficult. Research should also include determination of constituents responsible for astringency in peaches, apricots and strawberries intended for processing. Astringency is one of the important organoleptic qualities of fruits which governs their acceptability. At present there is no way of measuring astringency in a quantitative way because of the lack of knowledge about the fruit constituents which are responsible for this property. It is recommended that a study be made to isolate, identify, and determine the amounts of these constituents and how they vary with maturity so that this knowledge can be utilized toward the development of an objective test for astringency of peaches, apricots, strawberries, and other fruits, and possibly for maturity tests for these fruits, in order that they may be processed at their optimum quality.

MUTUAL EXCLUSION OF ASCORBIC ACID OXIDASE AND POLYPHENOL OXIDASE - WU

Progress and Findings - 1954 Recommendation "Accelerate work on the enzymatic changes in fruits and tree nuts as a basis for understanding and controlling changes which affect quality of agricultural products between harvest and processing, and during frozen storage of the unblanched product." (2/12)

Resources did not permit expansion of this research.

Because some plant tissues which darken when cut or crushed (due to polyphenol oxidase activity) contain no ascorbic acid oxidase, while other plant tissues rich in ascorbic acid oxidase do not darken enzymatically, the possibility suggested itself that these enzymes were mutually exclusive. A careful and critical examination at the Western Regional Research Laboratory of a number of diverse plant materials including many fruits and vegetables for ascorbic acid oxidase and for polyphenol oxidase (by a method which did not depend on endogenous substrate) seemed to support this idea, although there were some polyphenol oxidase-rich materials which may have had a trace of ascorbic acid oxidase. Conversely, certain of high ascorbic acid

oxidase fruits had minute amounts of polyphenol oxidase which could not be detected by the usual assay but only by prolonged histological tests. In these cases the activity appeared to be concentrated along the vascular fibers leading to the seed.

Some commodities such as tomatoes and oranges contain neither of these two enzymes. These commodities are high in ascorbic acid and retain this vitamin well in the fresh and processed form.

These results show more about the paths of oxidation of ascorbic acid in fruits. The fact that two of these paths are mutually exclusive may lead to simplified methods of control of ascorbic acid loss in processed fruit products.

Plans - It now becomes important to investigate if high vitamin C containing commodities have a different oxidative enzyme system which may result in the accumulation of this vitamin.

ENZYMATIC BROWNING CONSTITUENTS - WU

Progress and Findings - Fundamental studies on the constituents and conditions influencing the reactions involved in enzymatic browning have been continued at the Western Regional Research Laboratory. In a previous report, the presence of chlorogenic acid in a few different varieties of peaches was reported. A similar compound, neo-chlorogenic acid, discovered and named at this laboratory, was also reported previously to be in all varieties of peaches studied. Since publication of discovery of neo-chlorogenic acid, requests for samples of this browning substrate have come from various laboratories throughout the world. This last year's work has been concerned principally with isolation of large enough quantities of neo-chlorogenic acid to fully establish its structure.

The dependence of speed of browning on total amount of oxygen present (in the atmosphere in equilibrium with the reaction mixture) has been investigated. Studies with the polyphenoloxidase enzyme has shown that the speed of browning decreases slowly as the amount of oxygen is decreased, down to 5 or 10% oxygen. Below this level the effect of oxygen decrease is more pronounced. In 3% oxygen-97% nitrogen mixtures the speed is approximately one-half that in air, and at 1% oxygen-99% nitrogen mixtures the speed is about one-fourth the speed in air. It is interesting that although the speed is lower in mixtures containing less oxygen, if enough ascorbic acid is added to entirely prevent browning, the same amount of ascorbic acid will have to be used regardless of the amount of oxygen present. In other words, the only difference is that longer time is required to use up the same amount of ascorbic acid when there is less concentration of oxygen.

Plans - Structural determination studies will be continued on neo-chlorogenic acid. The development of the enzymatic browning substrates during maturation will be followed for several varieties of peaches which have been gathered this season. Investigations studying the effect of oxygen and ascorbic acid on the speed of the reaction when only small amounts of tannins are present are being planned.

Publications

"A New Isomer of Chlorogenic Acid from Peaches." Joseph Corse, Nature 172, 771 (Oct. 24, 1953).

ENZYME OF SUGAR AND ACID METABOLISM IN FRUITS - WU

Progress and Findings - The work on action of enzymes in changes in the sugars and acids of fruit has been continued at Western Regional Research Laboratory to furnish fundamental knowledge about changes taking place during conditioning for processing, during processing, and during holding of the processed product. In a study of the interchange of sugars in fruit, radioactive glucose was introduced into apple discs. Transfer of radioactivity from glucose to other sugars was followed by chromatographic separations and testing for radioactivity. Results showed that free fructose in the apple was not derived from free glucose. On the other hand, sucrose was significantly radioactive, in both the glucose and the fructose portions, so that it must be assumed that it was derived from the added glucose. Apparently oxygen is needed for this transformation of glucose. In the course of these experiments it was also shown that certain free amino acids were formed from radioactive glucose. This latter transformation took place either in presence or absence of oxygen. The interconversions of sugars into one another and into amino acids indicate some of the diverse metabolic reactions that can take place in the harvested apple. It is of interest that the interconversion of sugars is retarded by absence of oxygen.

In other work, the products derived from carbon dioxide absorbed by Bartlett pears were studied. When radioactive carbon dioxide was absorbed by the pear, radioactivity was found predominantly in the malic acid.

Plans - Work toward defining the reactions involved in these transformations will be continued as availability of personnel permits.

- G. Proposal for Committee Consideration - Accelerate work on the enzymatic changes in fruits and tree nuts as a basis for understanding and controlling changes which affect quality of agricultural products between harvest and processing, and during frozen storage of the unblanched product.

NUTRIENTS IN DECIDUOUS FRUITS AND TREE NUTS - HN

Progress and Findings - 1954 Recommendation, "Initiate research to determine in deciduous fruits and tree nuts the content of important nutrients including carbohydrate fractions and newly identified nutrients and determining the effect of common methods of household processing upon such values." (3/12)

Studies of content of amino acids, fatty acids, crude fiber and pantothenic acid in foods have been continued under previously available funds. Pantothenic acid values of over 200 foods have been completed and results are being prepared for publication. Values for 2 amino acids, cystine and tyrosine, have been obtained for a large number of protein-rich foods including almonds, cashews, defatted coconut, filberts, pecans and English walnuts.

Completed this year under contract has been an annotated bibliography and compilation of data on fatty acid content of commodities from 922 research reports published 1920 to 1950. The compilation was undertaken to indicate the relative value of different foods as sources of unsaturated fatty acids and to contribute to tables for estimating the fatty acid content of diets in this country. Many gaps in the information currently available were apparent from this compilation. Only about 25 percent of the reports pertain to foods and many of the values are tentative because of unsatisfactory methods or because analysis did not include all the important fatty acids. About 80 of the 922 reports dealt with the fatty acid composition of fruits, 105 with nuts.

Plans - Results of the pantothenic acid, fatty acid, and amino acid analyses of foods will be prepared for publication. Studies of "non-essential" amino acid content of foods will be continued. As the pantothenic acid studies are completed, the unit will direct attention to determination of the pyridoxine (another B-vitamin) in foods.

Funds provided for expansion in fiscal year 1955 are being used to initiate cross-commodity studies of vitamin B₁₂ and of minerals in foods. The literature relating to determination of vitamin B₁₂ values in foods is being reviewed and the use of modern equipment and procedures for determination of mineral elements in foods is being investigated. Funds were not sufficient to initiate a study of carbohydrate fractions in foods. See proposal for Committee consideration.

Of the 57 mineral elements reported in foods, special attention is to be given first to potassium, magnesium, cobalt, copper, and manganese because these are present in foods in amounts which can readily be measured in present laboratories and with present equipment. Although relatively more data are already available for calcium and phosphorus these elements will be determined in all newer types and forms of foods on which data are lacking. Later attention will also be given to molybdenum, strontium, and selenium, and perhaps sodium and iron if data available from other laboratories proves insufficient.

Proposals for Committee Consideration -

- H. Expand work on carbohydrates in foods to obtain basic information for more accurate estimation of the caloric values of diets, for planning diets where data on the starch, sugar, fiber or other type of carbohydrate may be essential, and for studying the physiological utilization of specific carbohydrates. The present method of determining total carbohydrates by difference is most unsatisfactory. All of the inaccuracies of the analytical procedures for determining fat, protein, moisture and ash are reflected in the value for carbohydrate by difference. Furthermore, the values often include nutrients such as the organic acids, which are not carbohydrate in nature. The American Diabetic Association, among others, is urgently requesting these data.
- I. Expand nutritive value analyses to determine the content of important nutrients in foods as commonly processed and eaten. Rapid changes in commercial processing of all types of foods -- and consequent changes in the type and extent of kitchen preparation required, is rendering obsolete many nutritive value figures now contained in tables of food composition. Dependable data on foods as eaten are needed by those appraising family and individual diets. They are wanted by nutritionists, dietitians and others responsible for food planning, particularly in controlled diets where content of calories, sodium or other constituents must be restricted precisely, or content of some nutrients enhanced.
- J. Expand work on food composition tables to cover more nutrients and to provide tables for specific uses. The cumulative file on nutrients on foods which is maintained by regular review of some 150 current periodicals, serves as the basis for answering many requests from consumers, clinicians, the food industry, and research workers. Preparation of expanded and additional tables from these materials would save time in answering many specific requests and make the information more widely available. Tables showing the average content of amino acids are in preparation, and a revision of tables in Handbook 8 is planned to include recently-identified B-vitamins and some minerals such as sodium in foods. There is increasing demand for tables showing the content of carbohydrate fractions, as well as tables showing range and differences in nutrient content associated with common conditions of production and processing, and the value of cooked foods as eaten.

Publications

"Availability of amino acids to Microorganisms. II. A Rapid Microbial Method of Determining Protein Value," Journal of Nutrition, 52, 375-381, March, 1954. - Horn, Millard J., Blum, Amos E., and Womack, Madelyn.

"Microbiological Procedure for the Assay of Pantothenic Acids in Foods: Results Compared with those by Bioassay," by E. W. Toepfer, E. G. Zook, and L. R. Richardson.

"Fatty Acid Content of Several Food Products," by C. Willard, R. D. Englert, and L. M. Richards. Jour. Am. Oil Chemists Soc., Vol. 31, No. 4, April 1954. p. 135.

"Energy Value of Foods -- basis and derivation," Agr. Handbook 74. 1954.

IMPROVED METHODS FOR DETERMINING THE PALATABILITY OF FOODS - HN

Progress and Findings - 1954 Recommendation, "Initiate research to develop more rapid and improved methods for determining the palatability of foods to aid in the evaluation of the quality of fruits and nuts as affected by agricultural chemicals." (6/12)

No funds were available to initiate systematic studies needed for development of improved methods.

As in the past, studies of the palatability of foods have been designed insofar as possible to permit some limited evaluation of methods. This year such an opportunity was afforded in studies of the flavor of experimental fruit jellies and of squash as affected by agricultural chemicals (coop. Ent.). In the studies of jellies, two methods of testing, ranking and scoring, and two types of panels, one comprised of 5 trained members, and the other of 40 untrained members were compared.

To determine whether differences in flavor of fruit jellies made with varying proportions of sugar to juice could be discriminated by taste, jellies varying in the amount of natural fruit flavor present were made, using proportions ranging from equal amounts to twice as much sugar as juice but having 62 percent soluble solids in the finished jelly. These were taste-tested by 40 untrained persons. In a triangle test, twenty-six of the people could distinguish between two samples having the largest difference. More people preferred the smaller proportion of sugar when the choice was between samples made from large versus small proportions sugar to juice. When the choice was between the medium and small proportions of sugar to juice, a larger number of people preferred

the medium proportion. A trained panel of 5 persons rated jellies with the same high, medium, and low proportions of sugar to juice on a 5-point scale for amount of natural fruit flavor. Mean scores ranged from 2.8 to 3.1 showing that they could detect little difference in the amount of natural fruit flavor in these samples. The variation in results from the two panels may be due to the difference in the methods used for evaluating flavor. The triangle test indicates only whether there is any difference between samples; while the scoring method attempts to measure the degree of difference.

Problems experienced by the panel members in evaluating differences in flavor of jellies led to another experiment on methodology of taste-testing. Samples of jelly were prepared from concentrated frozen grape juice diluted with different amounts of water so that the jellies differed in amount of grape flavor. Samples were presented in various ways and in varying numbers per session, and rating was done by ranking and by scoring. The differences among the samples were large enough that all members of the tasting panel could differentiate the samples by either the ranking or scoring method.

In the study of squash, a comparison was made of two scoring methods: (1) paired samples (one treated and one untreated) presented in a given order with instructions to taste a certain sample first but with no restrictions on retasting; and (2) four samples (one treated and 3 untreated) presented one at a time with 3-minute intervals between samples and no re-tasting permitted. In this method, a known reference sample was provided for use as a standard throughout the tasting session. In the first method the sample was served as slices while in the second it was mashed to obtain greater homogeneity. There were two rating sessions in each case and judges scored intensity of off-flavor and general acceptability.

These two methods gave different results. By the first method the untreated sample was rated lower on both palatability factors than the treated but the difference was not statistically significant. By the second method the untreated sample was rated significantly higher than the treated in one of the judging sessions and higher but not significantly so in the other session.

Scores for the untreated sample evaluated by the second method were more in the range of those for the untreated sample rated alone in training sessions where there was no possibility of carry-over of off-flavor from a treated sample. A considerably larger experiment would be required for definite proof as to the superiority of the method employing a reference standard over the paired scoring method.

Plans - Limited methodological studies as described will be continued until funds become available to undertake systematic research on improved methods of evaluation of palatability applicable to fruits and nuts. See proposal for Committee consideration.

FLAVOR EVALUATION OF INSECTICIDE-TREATED FRUITS - WU

A method has been developed which gives the tasters single samples of apple juice or apple sauce at intervals of four hours or more. The tasters are asked whether there is any off-flavor present. This presents the juice or sauce in much the same way that it would be consumed by the purchaser. Random use of treated and untreated (control) samples in a test lasting several days permits calculation of statistical significance of the results. This test is particularly interesting in that it eliminates two problems which are present in any tests which require side-by-side comparison of treated and untreated samples: (a) carry-over of off-flavor from a treated sample to an untreated sample, making both appear to have an off-flavor; (b) lack of a proper control sample, because of the necessity of using separate sprayed and unsprayed trees or blocks of trees, with the consequent possibilities of flavor variations which are not a result of insecticide application. This development in no way invalidates the triangular taste tests or other tests used in food appraisal, but it does appear to offer some advantages where insecticide use is to be evaluated. The system has been reviewed carefully for its mathematical soundness and validity of comparisons, and it appears that it should be widely useful in the entire field of effects of field treatment on quality of processed products.

Plans - The study of the use of the new flavor evaluation procedure will be continued for other insecticide-treated apple and fruit products, to provide further information as to its value compared with other proposed methods.

- K. Proposal for Committee Consideration - Expand studies to develop methods and procedures for determining the quality characteristics influencing palatability and generally associated with consumer acceptance of food; with emphasis on devising more rapid and precise methods for evaluation of food quality. Basic physiological, psychological, biochemical, and electrochemical reactions involved in sensory methods of evaluating food quality should be investigated in order to understand better the mechanisms involved. Supplementing sensory evaluation of such quality factors as color, flavor, and texture parallel research should be undertaken to develop and standardize selected objective methods of measuring the physical, chemical, and histological attributes of foods. Also new and improved experimental designs and statistical procedures would be developed.

Publications

Effect of Benzene Hexachloride Sprays on the Flavor of Fresh, Frozen and Canned Peaches. Gladys L. Gilpin and Elsie H. Dawson, Human Nutrition Research Branch; and E. H. Siegler, Entomology Research Branch. Journal of Agricultural and Food Chemistry 2 (15): 781-783. 1954.

A Report on the Freezing of prepared Foods. Elsie H. Dawson, Gladys L. Gilpin, Georgia C. Schlosser, Jessie C. Lamb, and M. Claire Endersbee. American Restaurant Magazine 38: 62-64, 142-151, February 1954.

New Time Freedom for Cooks. Agr. Research, Vol. 2, No. 11, May 1954. p. 14.

Freezing Combination Main Dishes, Home and Garden Bulletin No. 40, U. S. Department of Agriculture, July 1954.

Easy Main Dishes to Freeze. Elsie H. Dawson. Farm Journal, September 1954, pp. 119-121.

Recipes for Quantity Service. Food Service VII, PA-223, May 1953; Food Service VIII, PA-226, July 1953; Food Service IX, PA-233, November 1953; Food Service X, PA-238, April 1954.

PREVENTION OF DETERIORATION IN SHELLLED WALNUTS - WU

Progress and Findings - 1954 Recommendation "Expand research to determine causative factors for rancidity and darkening and to find the most effective practical means of increasing the shelf-life of tree nuts." (7/12)

Resources available have not permitted expansion.

It was reported previously by the Pasadena Laboratory that maximum color stability of shelled walnuts was obtained at an optimum moisture content, above and below which the walnut skin darkens at a more rapid rate under accelerated storage conditions. Therefore, it was of importance to determine if the same effect would be observed under extreme but more nearly normal storage conditions and to determine if the darkening of the walnut skin bears any relationship to the flavor of walnut kernels. During the past year it has been demonstrated that during storage at 100°F. a similar, but not identical, optimum moisture-stability relationship exists. The optimum moisture level was found to be very slightly higher for walnuts stored at a high (100°F.) temperature than that observed at the accelerated storage condition (140°F.). It

would appear that optimum moisture content varies with both the storage temperature as well as with the length of time of storage. The moisture optimum tends to decrease slightly as the storage time and temperature is increased but still lies within the range 2 to 3% moisture. Since objective physical and/or chemical tests are not available for overall quality evaluation of shelled walnuts, it was necessary to organize and train a taste panel and to initiate a study to determine if a correlation exists between changes in color of the walnut skin and the taste quality of the nut meats. The results of this study indicate that changes in color may be correlated satisfactorily with taste quality for a given lot of nuts originally light in color. However, other chemical characteristics of the nuts will have to be taken into consideration if a general, objective procedure is to be elaborated for the estimation of quality in any given sample of walnut kernels.

The effect of abrasion on the storage quality of shelled walnuts was determined by a comparison of commercially machine-cracked and carefully hand-cracked walnut halves and pieces at various storage periods up to 6 months at 85°F. Results of this experiment clearly indicate that the commercial, machine-cracked nuts had a shorter storage life than the hand-cracked walnuts obtained from the same lot and which had been handled with special care to minimize abrasion and loss of skin. However, effects of abrasion were minimized when similar lots of walnuts were conditioned to optimum moisture content. It would appear that adjustment of walnuts to a near optimum moisture level not only reduces the rate of darkening during storage but materially reduces the rate of development of rancidity. Experiments are in progress to determine if the usual deleterious effects of oxygen and light on commercial walnut meats may be minimized by adjustment of the moisture content of the kernels to within the optimum moisture range.

It is known that antioxidants, coatings, and inert gaseous atmospheres have a beneficial effect on the stability of commercial (high moisture) walnuts. However, the effects of these variables on nuts conditioned to optimum moisture content remain to be determined.

The desirability of adjusting walnut meats to an optimum moisture content has brought several new problems into focus:

1. What types of economical packaging materials may be employed as a protective, moisture-impermeable carrier for small packages of walnuts sold at the retail level?
2. What is the character of the relationship between moisture content of the nuts and its equilibrium relative humidity?

3. Is the optimum moisture content a function of the relative humidity alone or do compositional variables such as carbohydrates, fats, and proteins influence the moisture-relative humidity relationship?
4. Does the optimum moisture content of shelled nuts vary with the variety of walnuts?

During the past year the problem of finding a suitable packaging material for shelled walnuts has been given considerable attention. At the present time there are more than a dozen different types of transparent plastic films available commercially in addition to foil, paper, and other non-transparent plastic films. Many of these materials are available in various colors, thicknesses, and other physical properties. A large number of factors, many of which are not immediately apparent, must be taken into consideration during the development of a package which will maintain the desired chemical, physical, and organoleptic stability of the product. Among these factors are costs of material, packaging machinery and labor, potential production rates, and film characteristics including color, thickness, printability, sealability, transparency, tear strength, tensile strength, burst strength, moisture and gas permeabilities, chemical, light, high and low temperature stabilities, and resistance to insect penetration. Lamination of two or more films permits an almost unlimited array of properties to be incorporated into the final packaging material. Through the cooperation of several commercial converters and film manufacturers over 50 different types of films and laminations have been obtained and tested for suitability in packaging shelled walnuts.

(see Marketing Research section for report on other nut packaging tests)

Plans - It is planned to subject several of the more promising plastic films now being tested to further evaluation tests including moisture and gas permeabilities, as well as actual walnut stability studies, during the next year. As new packaging materials become available from manufacturers, they will be evaluated as packaging materials for shelled walnuts. Moisture-relative humidity equilibria will be determined for different varieties of shelled walnuts in order to determine if the stability of walnut meats is influenced more strongly by actual moisture content or by ambient relative humidity.

L. Proposal for Committee Consideration

Materially expand research to determine the causative factors for rancidity and darkening, and to find the most effective practical means of increasing the shelf-life of tree nuts in view of the rapidly increasing importance of marketing of tree nuts in shelled form. The investigation should include: studies on the basic chemical composition of the walnut kernel and walnut pellicle before and after the darkening and development of rancidity; the effects of light, heat, and oxygen on the rate of deterioration; histological studies to trace relations between cellular structure of the walnut tissues, rate of darkening of the pellicle, and rate of rancidity development; microbiological studies to determine whether microorganisms may be involved in the deteriorative changes and to determine effective control measures for reducing microbial populations; the effects of antioxidants, and other chemical agents which may slow down or prevent darkening and rancidity; the effectiveness of cathode and X-ray radiation in reducing insect and microbiological contamination; and tests of the ability of various foils, plastic films, and other packaging materials to protect the product against rapid deterioration. The same studies should be made on pecans.

IMPROVING THE QUALITY OF DRIED PRUNES - WU

Progress and Findings - 1954 Recommendation "Expand prune research to include work on effects of post-harvest handling upon quality of dried prunes." (8/12)

Funds were not available to expand prune research.

Variation in quality of dried French prunes is caused by many factors, some of which can be controlled. One of these is to choose the correct harvest time for the crop from a particular orchard in any given year. The criteria for determining when this crop should be picked for maximum quality in the dehydrated prune are not easily set forth. The work reported below was done by the University of California under contract.

As judged by internal and external appearance, quality of prunes, except Robe, will be good if chlorophyll has disappeared from the flesh at the time of harvest. However, if harvest is begun as soon as this stage of maturity is attained there is a substantial sacrifice both of yield and size. Largest size and greatest yield result from delaying harvest until the fruit is fully ripe and soft (1-2 pounds firmness).

If it is necessary to harvest over a period as long as three weeks, best average quality results from beginning the harvest prior to peak maturity, which is about 7-10 days after chlorophyll disappearance and when the soluble solids has reached about 24 percent. In this way harvest may be completed before much fruit is overripe and damaged by breakdown or heat injury.

In acceptance tests, the first and second preference rating is for samples with a sugar-acid ratio of 35, compared with 31.1 and 26.5 for third and fourth, respectively, in dried French prunes. There is no significant differences between first and second preference ratings with respect to sugar-acid ratios.

The ratios of soluble solids/acid are 59, 63, 61, 41, for the four ratings compared with an overall average of 50. Thus, while soluble solids content is a less sensitive measure of preference, the lowest rating was nevertheless awarded to samples with an appreciably lower ratio than the average.

It seems unavoidable that the soluble solids test by refractometer reading must be one of the field criteria for gauging quality. The maximum soluble solids attainable without texture deterioration, formation of gas pockets and similar flesh defects, will reflect high sugar and relatively low acid, and according to the taste panel will be awarded a higher preference rating.

Plans - This concludes the contract work done by the University of California under this project.

- M. Proposal for Committee Consideration - Expand research to develop better methods for manufacture of improved dried prune products, with particular emphasis on studies of preprocessing practices and of means for controlling microbial spoilage. New production practices, such as mechanical harvesting and spray-thinning, have shown promise as labor-saving methods in prune orchards. Little is known about the specific effects of these practices on quality of dried prunes, and processors are reluctant to permit widespread use of these treatments until sufficient information has been gathered to permit a sound judgment. Also, effects of the various post-harvest handling methods are not clearly known, in terms of final product quality, and these factors should be further investigated. One yet unsolved problem in making a satisfactory dried prune product is that of spoilage. Under the high relative humidities often found in shipping and terminal warehousing of dried prunes, the surface of prunes becomes wet, and frequently

spoilage organisms naturally present on the skin are able to multiply and cause considerable losses, particularly where the high humidities cause surface condensation. Research should be initiated to develop processes for economically controlling such microbial spoilage. Increased knowledge in these fields should assist materially in the improvement of quality and toward increased use of dried prunes.

RAW PRODUCT QUALITY AND PROCESSING VARIABLES ON PUREED FRUITS - WU

Progress and Findings - 1954 Recommendation "Initiate research studies to determine the extent to which the color and texture of pureed fruits are dependent upon the quality of the raw material and the extent to which this quality can be varied by changes in processing conditions." (9/12)

At the Western Utilization Research Branch, this work could not be initiated because of lack of funds. From the Eastern Utilization Research Branch, a contract was recently negotiated with New York Agricultural Experiment Station, Geneva, N. Y., for investigation of the improvement of color, flavor, and texture of purees from eastern grown peaches through studies of the relationship between processing variables and quality of raw material.

Plans - This contract study will be carried out over a period of three processing seasons.

- N. Proposal for Committee Consideration - Expand research studies to determine the extent to which the color and texture of pureed fruits are dependent upon the quality of the raw material and the extent to which this quality can be varied by changes in processing conditions, to include other fruits and western grown peaches.

PHYSIOLOGICAL ACTIVITY OF GRAPE PHLOBATANNIN - WU

Progress and Findings - 1954 Recommendation "Expand studies on the physiological activity of tannins and phlobatannin in certain fruits for the purpose of evaluating their medical importance." (10/12)

Resources did not permit expansion.

Grapes and raisins contain phlobatannin, a substance related chemically to rutin and other flavonoids now being used therapeutically. As shown by earlier work at Western Utilization Research Branch, grape phlobatannin produces at least some of the physiological actions obtained after rutin administration. It is desirable to know more about the physiological activity of this material and to determine whether or not its chronic toxicity is as low as that of rutin. For this purpose a substantial amount of the material has been produced, and the prolonged feedings of this product to experimental laboratory animals is being initiated.

Plans - Since the assessment of the physiological effects of phlobatannin in laboratory animals requires a period of two or three years it is planned to continue this phase of the investigation on phlobatannin from grapes to its logical conclusion.

- O. Proposal for Committee Consideration - Expand studies on the physiological activity of tannins and phlobatannin in certain fruits for the purpose of evaluating their medical importance. There is some evidence, from preliminary observations, to indicate that enzymatic browning materials (tannins) found in fruits such as chlorogenic acid, caffeic acid, and perhaps related components, modify the reactions of cutaneous capillaries of experimental animals to local irritation. The effect resembles that produced by rutin which is used therapeutically. This preliminary evidence should be followed up and the activity of these constituents be determined conclusively.

MAGNETIC RESONANCE METHOD FOR RAPID MOISTURE MEASUREMENTS IN FRUITS AND FRUIT PRODUCTS - WU

Work has been continued at Western Utilization Research Branch on the development of a rapid non-destructive method for moisture determination based on nuclear magnetic absorption. For measurements on inhomogenous materials (powders, etc.) the sample size which can be utilized in the present equipment is 0.6 cc. Efforts to increase the volume of the sample that can be tested and thus to allow use of more representative samples have not been successful. For liquid samples, however, satisfactory performance has been obtained on 15 cc. samples. As a further aspect in the development of the method, means have been devised to calibrate the magnetic absorption apparatus in terms of a single standard substance (water) and thus to eliminate the need for individual calibration on various types of fruit to be tested. The use of water as a reference standard is a significant advance in the development of a procedure for determination of moisture in fruit on an absolute basis. This development, together with a new method which has been devised for continuous standardization of the absorption instrument, are essential steps in the application of the new method on an industrial rather than on a laboratory basis.

Plans - Future work is to be devoted primarily toward simplification of instrumentation with a view to industrial application. Since this aspect of the work is equally applicable to fruits or vegetables, the fruit project will be terminated and future reports will be made on the vegetable project which has been under investigation concurrently.

Publications

"Moisture determinations of foods by hydrogen nuclei magnetic resonance." T. M. Shaw, R. H. Elsken and C. H. Kunsman, Jour A.O. A.C. 36, 1070 (1953).

"Quantitative measurement of magnetic absorption utilizing a null-balance system." R. H. Elsken and T. M. Shaw, Physical Review 93, 943A (1954).

LAXATIVE PRINCIPLE IN PRUNES - WU

Work on the isolation and characterization of the laxative principle in prunes has been started at Western Regional Research Laboratory. Fresh prune juice and prune juice concentrates have been fractionated by extraction with organic solvents, and the fractions have been assayed for purgative action by oral administration to albino mice. Laxative action has been found to be absent in the butyl-alcohol-soluble fraction. This disagrees with the earlier reports in the chemical literature, which stated that 3,3-bis (4'-hydroxy-phenyl) oxindole and its diacetoxy derivative (diacetyldioxyphenylisatin) were the laxative principle in prunes. On the basis of the present work, it appears that these compounds are not present in prunes. Evidence accumulated so far indicates that the laxative principle may be a glycoside, not soluble in organic solvents such as butyl alcohol until removal of the sugars which are part of the molecule.

Plans - The work on the isolation and identification of the laxative principle of prunes will be continued.

TIME-TEMPERATURE TOLERANCE OF FROZEN FRUITS - WU

Studies of effects on frozen fruits of temperatures and times encountered in commercial transportation and distribution have been continued at the Western Utilization Research Branch. The object of this work is to provide a sound basis for guiding process development so that products may be made more stable to the variable temperature conditions encountered in handling subsequent to processing, and to supply the necessary information for the establishment of a sound schedule for the distribution of frozen fruit products in general.

Strawberries: Since last year's Annual Report, twenty-six additional lots of commercially frozen strawberries were obtained for study. Eight of these were procured from the Louisiana-Tennessee area, two from Michigan and the remainder from the Pacific Northwest and California. Approximately half of the samples were packed in composite metal end cartons and half in hermetically sealed tin cans. Since much of the previous work has been done at a temperature of 20°F., all lots were compared at 20°F. In addition, several of the samples were subjected to time-temperature cycles which were designed to simulate distribution from packer to consumer. Two large lots were subjected to regularly fluctuating temperatures in the following ranges: -10 to +10, 0 to +20, 15 to 25, and 10 to 30°F.

Using the triangle taste test and a laboratory trained panel, comparison at 20°F. shows that approximately 95% of all the samples studied were detectably different from their controls (held at -20°F) after only 6 to 18 days. Packaging material did not appear to make any significant difference in the time at which the first detectable flavor change occurred, but on prolonged exposure to 20°F. the degree of deterioration in the paper containers was greater than in tin cans. The most pronounced difference observed in berries packed in the two types of container was in ascorbic acid retention at 20°F. In paper containers ascorbic acid was lost at the rate of approximately one milligram percent per day until practically all the acid was oxidized. On the other hand, in tins the initial rate was much lower, and after 20-30 percent of the original amount was oxidized there was little or no additional loss up to 3 months' holding at 20°F.

Although there was considerable variation between samples, a definite color difference was established between control samples and those kept at 20°F. for 3-4 weeks.

As reported last year, the samples which experienced simulated rail transportation (0 to 23 to 0°F. in 14 days) were either indistinguishable from control samples at -20°F. or only slightly different in organoleptic quality. Another 3 to 4 days at 10-20°F., however, was sufficient to cause detectable flavor changes in most of the samples.

The organoleptic data indicate that no significant difference exists between samples subjected to the fluctuating cycles and those held at the mean temperature for the same length of time, except for the -10 to +10°F. cycle. In the latter cycle the 0°F. samples were significantly better than the fluctuating samples after 3 months. This is probably due to the fact that very little or no change occurs during 3 months at 0°F., whereas appreciable changes occur at 10°F. even after a few weeks. Ascorbic acid changes in samples subjected to the fluctuating cycles indicate that the rate of loss is always greater in the samples which are fluctuated as compared with the samples held at the mean temperature.

Plans - Further work on strawberries will be concerned with packs, in 30-pound containers, used for manufacturing. Studies will be made of changes taking place under the various time-temperature conditions which may be found in commercial distribution, as well as of the rates of temperature change at various points within the product under conditions of fluctuating external temperatures. Importance of changes in the product will be determined by testing quality of the manufactured products, such as preserves or ice cream, for which the particular pack is intended. Studies of the microbiology of frozen strawberries under distribution conditions will be made.

Raspberries: Since the last report, ten more "lots" of commercially frozen raspberries from the Pacific Northwest have been obtained for study at Western Utilization Research Branch. These have been compared after being kept at 10, 15, 20, 25, and 30°F. Even though first detectable changes have been found after two to three weeks at 20°F., these changes are largely due to difference in sweetness between stored and control samples and not to flavor deterioration. Many of the panel members correctly identifying duplicates in a triangle preferred the stored samples on the basis of a better sugar-acid balance between fruit and sirup. Generally this fruit has been more stable at temperatures of 10-30°F. than have strawberries.

As reported last year, the ratio of the color in the drained fruit to the color in the drained sirup serves as a useful indication of the time-temperature history of the product. The ratio for samples held at 0°F. or below varies from 3.5 to 4.5 depending on such factors as variety, maturity, processing conditions, etc. During holding at temperatures of 10-30°F. the color ratio value drops in exponential fashion at a rate depending on the temperature and gradually approaches an equilibrium value of 1.0. At 20°F. this value is reached after 20-40 days.

The distribution of soluble solids between fruit and sirup is also a useful indicator of the temperature history of the sample, particularly for temperatures above 25°F. For samples stored at 20°F. or below there is no significant change in the soluble solids of fruit or sirup with increasing storage. At 25°F. the soluble solids content of the fruit gradually increases and that of the sirup gradually decreases with increasing holding time, but equilibrium between fruit and sirup is not reached for periods up to two months at this temperature. If the fruit is kept at 30°F., however, the soluble solids of the fruit is essentially equal to that of the sirup after 3-4 days. Therefore, the soluble solids measurement in drained fruit and sirup may serve as a very simple indicator as to whether or not the fruit has been thawed.

Plans - The stability of raspberries leads up to the belief that this fruit will not be important in determining proper time-temperature conditions for mixed shipments or storage of frozen fruits. Work on the time-temperature tolerance of raspberries is essentially finished. Studies of the microbiology of frozen raspberries under distribution conditions will be made.

Peaches: Additional lots of frozen peaches from Western growing areas were obtained for this work at WURB. Browning of the slices has been established as the first and most important change, from the commercial standpoint, of adverse time-temperature histories. It has been further shown that this is a function of the headspace in the container, provided oxygen is available. Ascorbic acid loss (from peaches and sirup fortified in the usual way), which occurs to a substantial extent before browning of the slice is evident, is also, of course, related to oxygen availability. Peaches in the usual composite container (fiberboard body, metal ends) lose ascorbic acid continually under adverse storage conditions. If the fruit is packed in tin cans under a vacuum of 15-20 inches (10-15 inches Hg residual pressure) there is little or no ascorbic acid loss, no browning, and no important flavor deterioration at temperatures from 10° to 30°F., over periods many times the acceptable life of peaches in the composite container. From this standpoint, it is perhaps unfortunate that the industry is not continuing its initial surge of 1952-53 to the use of tin cans for frozen fruits.

Plans - The work on peaches is essentially finished. Samples from Georgia were obtained this year for comparison to those from other areas. Studies of microbiology of frozen peaches under distribution conditions will be made.

Red Sour Pitted Cherries: During the past two seasons samples of red sour pitted cherries were obtained from the Michigan area for further study at Western Utilization Research Branch. These were packed in No. 2 enamelled tins with heavy sirup and were compared at temperatures of 20 and 25°F. Similar to the results found for peaches, discoloration of cherries in the headspace occurs long before any flavor changes can be detected. Even after $1\frac{1}{2}$ months at 20°F. the flavor of fruit baked in pies was not readily discerned from control samples. In non-hermetic containers, counting the number of discolored cherries gives a good indication of time-temperature damage, but in hermetic containers with little headspace the number of discolored cherries does not change a great deal with increasing storage time. As for raspberries, however, the color ratio between fruit and sirup is a good indicator of time-temperature history. It was also found that the time and temperature of holding could be followed by the texture of the drained fruit. These measurements were made with the tenderometer, which indicated a definite increase in the toughness of cherries during storage at 20 and 25°F.

Plans - Further work on red sour cherries will be concerned with the packs, in 30-pound containers, for manufacturing. Studies will be made of the changes which take place under the various time-temperature conditions which may be found in commercial distribution, as well as of the rates of temperature change at various points within the product under conditions of fluctuating external temperature. Importance of change in the product will be determined by testing quality of the manufactured product, such as pies, for which the pack is intended.

SOLUBILITIES AND PHASE EQUILIBRIA OF SUGARS AT LOW TEMPERATURES - WU

The properties of pure sugar solutions at freezing preservation temperatures are of basic importance in determining texture and appearance of fruits frozen in sugar. From data obtained in a study of the freezing behavior of glucose solutions, a useful table of refractive indices as a function of glucose content and temperature (20 to 30°C) has been compiled. Even at high sugar contents (68 per cent), glucose and fructose solutions have been found to have practically identical freezing points, contrary to published results. The marked tendency of glucose hydrate to crystallize spontaneously was again noted in the course of this work, emphasizing its probable importance in freezing preservation of fruits and juices containing high glucose concentrations.

Plans - It is planned to complete this project during the coming year.

Publication

"Photometric Determination of Aldoses in the Presence of Ketoses."
F. Stitt, S. Friedlander, H. J. Lewis, and F. E. Young, Anal. Chem.
26, 1478 (1954)

PROCESSING QUALITY OF NEW STRAWBERRY VARIETIES AND HYBRIDS - WU

Progress and Findings - Thirty-three hybrid selections of strawberries from the plant breeding program at the Western Washington Experiment Station were studied for processing qualities at the Puyallup Laboratory. These hybrids were compared with the two popular commercial varieties in this area, Marshall and Northwest. Berries which showed relatively high loss of liquid upon thawing (drip) were scored low on texture by a small, trained panel. Ascorbic acid content, soluble solids, pH and color were measured on these hybrids, and on the basis of these and other observations ten of the hybrids were selected for more intensive study as to processing quality. This elimination process is designed to result in the eventual release of one or more of the hybrids for commercial production sometime in the near future.

Plans - Processing tests will be made on the hybrids selected during the past season, and other newly developed hybrids will be tested for suitability for processing as they appear.

PROCESSING QUALITY OF NEW RASPBERRY VARIETIES - WU

Progress and Findings - One of the hybrid selections of red raspberry that had shown excellent quality attributes during the testing program at the Western Washington Experiment Station was released for commercial production during the past year under the variety name Puyallup. This new variety, two established commercial varieties, and a promising hybrid selection have been included in this year's experimental packs at the Puyallup Laboratory. Subjective evaluations by a panel of several hundred tasters on a Farmers' Field Day and by a small, trained panel have shown that the new variety and the hybrid selection both compare favorably with accepted commercial varieties. Measurements of color, loss of liquid upon thawing (drip), and yield of berries after mechanical grading are three objective methods used in evaluating the adaptability of raspberries to processing. These data, together with other observations, have been of assistance to horticulturists in discarding some hybrids and focusing attention on others that are more promising.

Plans - New hybrid selections will be tested for suitability for processing as they are developed in the plant breeding program.

PROCESSING QUALITY OF NEW VARIETIES OF FREESTONE PEACHES - WU

Progress and Findings - Canning and freezing studies were made on 26 horticulturally promising new varieties of freestone peaches by the Prosser Laboratory in cooperation with the Irrigation Experiment Station. Ranger, Redhaven, Fairhaven, Sunhigh, Loring, and a numbered variety, B-12156, were considered sufficiently promising in canning quality to warrant more detailed study. These varieties would be especially useful in extending the relatively short commercial canning season because Ranger and Redhaven ripen about 4 weeks before Elberta, while Fairhaven and B-12156 are about 3 weeks earlier, and the others about 2 weeks earlier. The freezing preservation studies were preliminary and will require further study before promising varieties can be selected for detailed study. Results of these studies are preliminary and intensive investigations of both horticultural characteristics and processing quality must be made before recommendation for commercial trial can be made.

Plans - Studies will be continued in evaluating the processing quality of new freestone peach varieties under trial at the Irrigation Experiment Station. A special effort will be made to develop objective methods for determining texture, color and handling qualities such as bruise resistance and freeness of pits.

PROCESSING QUALITY OF NEW VARIETIES OF SWEET CHERRIES - WU

Progress and Findings - Studies were continued by the Prosser Laboratory on the processing quality of new sweet cherry varieties being tested at the Irrigation Experiment Station. Of 7 new sweet cherry varieties studied during the 1953 season, Van and Sam varieties were considered especially promising for canning. Sam variety, which is heart-shaped, develops a color similar to that of Bing. Van variety has a plump shape which is more characteristic of Bing but ripens about 5 to 6 days later than Bing as indicated by color and sugar content. When harvested 5 days after Bing the color is comparable to Bing. Both Van and Sam appear to remain desirably firm when allowed to become fully ripened for harvest. While the flavor of both was considered good, neither had the flavor characteristic of canned Bing. The Sam and Van varieties were developed in British Columbia and are of special interest to sweet cherry growers because of their ability to pollinize the Bing, Royal Ann and Lambert varieties.

Plans - It is planned to continue to cooperate with the Irrigation Experiment Station in the appraisal of the processing quality of new sweet cherry varieties as they become available.

PROCESSING QUALITY OF NEW APRICOT VARIETIES - WU

Progress and Findings - Canning studies on promising new apricot varieties under test in the Irrigation Experiment Station apricot breeding and testing program were continued by the Prosser Laboratory. None of the new varieties so far studied were considered as good as Blenheim, the standard canning variety. Purees made from Wenatchee Moorpark, Sun Glo, and Blenheim were submitted to a large packer of baby food for evaluation as baby food stock with the following results: Blenheim is satisfactory for this use; Wenatchee Moorpark is acceptable but less desirable because of high acid content; and Sun Glo is considered unsuitable because of the large amount of acid present.

Plans - It is planned to continue cooperation with the Irrigation Experiment Station in the appraisal of processing quality of new apricot varieties as they become available.

THE EFFECT OF GRADE, MATURATION, AND OTHER FACTORS ON THE QUALITY OF APPLE JUICE - WU

Progress and Findings - Studies begun in 1952 on the effect of method of fruit handling on the quality of juice obtained from Jonathan, Golden Delicious and Winesap varieties were continued by the Prosser Laboratory in cooperation with the Tree Fruit Experiment Station, Wenatchee, Washington. Results of the 1953 study were in general agreement with those obtained in 1952. Studies on the flavor of juice prepared from apples sprayed with Systox, a newly-developed systemic insecticide that has special value in the control of mites and aphid, showed that this spray caused a detectable off-flavor in the juice. Further investigation showed that the off-flavor was also detectable in the fresh fruit after about 7 months cold storage. These studies indicate that an off-flavor problem may be encountered if this insecticide is used on apples.

Plans - These studies are being continued with juice-grade fruit commercially available to processors from Pacific Northwest apple packing firms during 1954-55 pressing season to determine what changes should be made in current fruit handling methods in order to improve the quality of commercially prepared juices.

RIPENING FREESTONE PEACHES FOR PROCESSING - EU

Progress and Findings - Although the 3-year contract on processing freestone peaches (Contract A-1s-32680) with the Michigan Agricultural Experiment Station has been completed, the following information was not available for last year's report:

The yield of canned or frozen peach slices is affected by wilting losses during ripening and by skin and pit losses during processing. Fruit requiring more than 7 days to ripen and peaches ripened at temperature above 80°F. showed excessive losses from wilting, often as high as 30 percent. Such fruit usually had an unattractive orange color and poor flavor. The results of these studies emphasize the desirability of harvesting peaches 3-7 days before the tree-ripe stage and ripening them at moderate temperatures (70°F. or lower).

Fruit ripened at high temperatures (80 to 90°F.) and moderate to high humidity was difficult to peel, and had high skin losses. The percentage of pits was not greatly affected by ripening treatments. The recommended procedure of harvesting peaches 3 to 7 days before fully ripe and ripening at 70° gave yields of approximately 85 percent of canned or frozen slices. These yields are considered satisfactory.

Plans - This contract study has been completed and all experimental data have been reported.

VARIABLE QUALITY OF HEAT PROCESSED SOUR CHERRIES - EU

Progress and Findings - Much of the work at the Eastern Utilization Research Branch on heat processing of sour cherries (whose farm value is about \$20,000,000) has been concluded. A survey study of 26 processing plants showed that there was no completely standardized method of processing cherries, even within the same plant. Just how the variations in preprocessing and processing steps affect the quality and yield of final product has been the subject of much of our work. We are concluding that three principal factors have a strong effect on yield and quality. These are extent of bruising of cherries, period of delay after bruising, and temperature of the delay period.

Bruising affects the processing of cherries in many ways. Bruising during picking, followed by a delay period at a warm temperature, causes the development of scald spots or blemishes on cherries, loss of red color, and loss of flavor. Bruising determines how long cherries will keep in sound condition before processing. This in turn affects the operating schedule and labor policy of the plant. Bruising in the plant just prior to pitting causes defective pitting, inclusion of pits in the canned product, poor character of fruit, and low drained weight. Excessive bruising was observed to occur in many plants. Some lots of raw cherries show the effects of bruising more readily than do others. Soft textured cherries are particularly susceptible. Obviously some measure of control over bruising is desirable if high quality and high yield are to be maintained.

Plans - The descriptive phase of this study has been completed. However, for an understanding of changes in tissues induced by processing variables, fundamental studies on structure and composition are planned.

INFLUENCE OF PRE-FREEZING DELAY ON THE DRAINED WEIGHT OF FROZEN
CHERRIES - EU

Progress and Findings - The quality and yield of processed RSP cherry products are influenced by cultural practices and by post-harvest and processing treatments. One of the processing variables is the delay between processing and freezing. Unusually long delays are incurred when the processed product has to be trucked long distances to freezing facilities. At the suggestion of the Refrigeration Research Foundation and representatives of the cherry processing industry, studies on the influence of pre-freezing delay on drained weights were initiated during the 1953 season in cooperation with the Agricultural Marketing Service and the following commercial companies: Knouse Foods Cooperative, Inc., Peach Glen, Pa.; Cherry Growers, Inc., Traverse City, Mich.; and the W. A. MacIntosh Company, Geneva, New York. Pre-freezing delay caused a progressive decrease in drained weight of the samples packed in Michigan. In the New York experiments, however, increases in drained weights were obtained with pre-freezing delay periods up to 24 hours. The seemingly contradictory results may be accounted for, at least in part, by the difference in freezing rates at the two plants. Other data obtained in this investigation indicated that the response of cherries to pre-freezing delay may be influenced by other factors such as the sweetening agent and the method of adding it, and the quality and condition of the fruit. These latter experimental variables were included in studies made on the 1954 crop.

Plans - This investigation will be continued for at least one more season.

PROCESSING OF SOFT SOUR CHERRIES - EU

Progress and Findings - In the second year of a 3-year contract (A-1s-33704) study on the processing of soft cherries by the Michigan Agricultural Experiment Station, various pre-processing treatments and additives were applied to soft cherries to improve their texture, drained weight, and acceptability for pies. Normally firm fruit was obtained from southwest Michigan. Soft fruit was obtained from an orchard in southwest Michigan using a high rate of nitrogen fertilization. The soft fruit was significantly lower in soluble solids and drained weight than the normal fruit. The soft fruit from southwest Michigan did not show improvement in drained weight when subjected to prolonged soaking in cold water, but a sample of soft cherries from northern Michigan did respond to this treatment. Soaking in CaCl_2 solution before canning improved the texture and drained weight of soft cherries from both regions. Calcium gluconate and calcium citrate were more effective than the chloride and sulfate salts for improving the texture of soft cherries.

These results differ slightly from those obtained in 1953 where all four calcium salts were equally effective. Pectin was not a satisfactory additive for soft cherries, since it failed to improve texture or drained weight and often resulted in an unattractive product due to gel formation. The addition of one ounce of sugar to each No. 2 can of cherries gave a canned product with a slight improvement in drained weight and considerable improvement in texture, visual appearance, and color. Soft cherries packed with added sugar generally rated higher in quality for pies than normal cherries canned in water.

Plans - No work was done during the 1954 season, since late spring frosts ruined the crop from the test plots. This contract study will be resumed in 1955.

DEVELOPMENT OF NEW AND IMPROVED PRODUCTS, PROCESSES AND EQUIPMENT

HOME PRESERVATION OF JELLIES WITH ADDED PECTIN - HN

Progress and Findings - To obtain background information on pectin products sold for home use, jellies made according to various manufacturers' directions were prepared from strawberries, cherries, peaches, and bottled grape juice. The "set" of jellies made from two liquid and three powdered pectins ranged from 72 to 120% according to fluidimeter measurements where a range of 80 to 100% set is considered very satisfactory.

Natural fruit flavor was scored as weak to moderately weak in these jellies, and judges' comments suggest that the natural fruit flavor may have been masked by a flavor too sweet in many jellies, and by a flavor too acid in a few. The finished jellies made according to pectin manufacturers' directions ranged in acidity from pH of 2.80 to 3.52, practically the entire range possible for gel formation. The soluble solids in the finished jelly ranged from 60 to 67%, a range which is generally considered satisfactory. Formulas for homemade jelly using various commercial pectins are being developed.

It has been found that for each fruit satisfactory jellies can be made using one formula with all powdered pectins for household use on the market and a second formula with the liquid pectins. This also holds true for jams. However, different formulas are required for jellies and jams because of the skin and pulp solids included in jams. Laboratory and home experiments with formulas adjusted for use with market units

of commercial pectin and a 1-minute boiling period on jellied fruit products made from strawberries, blackberries, currants, cherries, plums, grapes, and peaches have been completed. To establish a basis for determining the endpoint of cooking jellies with the desired percent of soluble solids, evaporation losses as affected by size of recipe, fast- or slow-heating burners, and various cooking periods were determined in the laboratory.

Tests on jellies made with both liquid and powdered pectins gave no indication that grape juice jellies changed in firmness during storage from 1 day to 1 week and 1 month. Tests with peach, plum, and cherry jellies after storage for 6 to 8 months showed that these jellies had increased in firmness during storage. Tests are in progress to obtain more information concerning set of jellies upon storage for periods between 1 month and 6 months.

Comparison of palatability judgments by an untrained panel of 40 and a trained panel of 5 people has given some useful information on flavor evaluation. (See Improved Methods for Determining Palatability).

Plan - Experiments with peaches, grapes, and apples will be carried out in the coming months and data from all studies will be evaluated. The present popular publication of this Branch, "Homemade Jellies, Jams, and Preserves," (FB-1800) will be revised to include procedures for use of added pectin, and procedures for making jellies without added pectin will be brought up to date.

CONCENTRATED FRUIT PRODUCTS

1954 Recommendation "Expand research on concentrated fruit products and where necessary initiate new lines of research and development." (4/12)

Resources did not permit expansion at either the Western or Eastern Utilization Research Branches. However, at the latter Branch research has been widened to new fruits, devising improved processes and achieving better storage properties.

PRUNE JUICE AND CONCENTRATE - WU

Progress and Findings - Further studies of the comparative stability (flavor and color) of single strength and concentrate juice made from fresh Italian prunes were made during the past year at the Western Regional Research Laboratory. Preliminary results of these studies

(six months) indicate that the four-fold concentrate tends to deteriorate at a faster rate during storage at either 40°F. or 70°F. than does the single strength juice. The shelf life of the concentrate stored at 70°F. appears to be about 6 months.

Concentrate kept at 40°F. and single strength juices kept at both 40°F. and 70°F. were still acceptable after this period of time. Deterioration in color (browning) was noticeable only in the concentrate that had been kept at 70°F.

Plans - Upon completion of current holding tests, active research work on this project will be terminated. It is expected that considerable time will be devoted in the next year or two to explanation of the process to prospective packers and to aiding such processors in the preparation of trial packs.

Publication

"Preparation of fresh Italian prune juice concentrates." L. H. Walker and D. C. Patterson. Food Tech. 8, 208-10 (1954).

STRAWBERRY JUICE CONCENTRATE - WU

Progress and Findings - Although experimental work on this project has been terminated, further progress can be reported in commercial acceptance of the method for preparing strawberry juice concentrate developed by the Western Utilization Research Branch. A major packer of strawberries in California has installed steam injection type essence recovery (developed by WURB) and vacuum concentration equipment for the production of 7-fold concentrate at a feed rate of 200 gal./hr. This packer plans to operate the equipment about nine months out of a year. Concentrated essence and concentrated juice are packaged separately as a result of WURB work, which shows that a superior jelly can be made by the return of essence to the completed jelly just prior to filling into jars. Ready acceptance of the product by Eastern jelly manufacturers has been due not only to the exceptionally good flavor mentioned above, but also because jelly made from concentrate is brilliantly clear as contrasted with the hazy appearance of the usual product.

Plans - No further work is planned on this project other than supplying potential manufacturers with the details of the process.

Publication

"Concentration of strawberry juice." L. H. Walker, G. K. Notter, R. M. McCready and D. C. Patterson, Food Tech. 8, 350-2 (1954).

VINIFEROUS GRAPE JUICE CONCENTRATE - WU

Progress and Findings - Based upon the varietal survey reported last year, intensive studies have been undertaken of processing techniques needed to produce juice of excellent quality from several of the more promising varieties. Some grapes of the Vinifera type have been found to be much more susceptible to oxidative and enzymatic action during processing than are Labrusca or Concord type grapes. Hence, it is necessary to develop an entirely new technique for processing certain varieties such as Muscat in order to retain the full, rich, typical flavor of the fresh grape.

Plans - It is planned to continue studies on the more promising of the Vinifera varieties in regard to (a) prevention of browning and flavor change in the preparation of single strength juices, (b) rapid and effective color extraction from dark-colored varieties combined with methods for clarifying the very pulpy material resulting from high temperature extraction, (c) effective essence recovery from highly aromatic varieties, (d) concentration of juice without changes in color or flavor, and (e) suitability of products for such uses as in beverages, beverage bases and jelly stock.

STORAGE OF SUPERCONCENTRATED GRAPE JUICE - EU

Progress and Findings - Storage tests at 73°F. and at 100°F. have now been completed on sweetened 7-fold Concord grape juice superconcentrates. These showed that if the concentrate is hot packed in the conventional way in double coated enameled seam striped cans, it will store satisfactorily at 73°F for a year. This is an important finding in that it enables the concentrate to be marketed through ordinary channels without refrigeration.

At 100°F. the shelf life was less than 2 months.

Plans - No further storage tests are contemplated on grape juice concentrates. Future work on grape juice will involve studies on simpler means of concentration and essence recovery (see p. 105).

GRAPE JUICE POWDER - EU;WU

Progress and Findings - There was reported last year from the Eastern Utilization Research Branch, the development on a pilot-plant scale of a process for preparing a powdered grape juice product with good

retention of aroma during drying. This is accomplished by careful control of the drying conditions and incorporation of sucrose and essence. Storage tests on this product have shown that it stores well for 6 months or more at 100°F. when packaged with a desiccant and preconditioned as is done with powdered orange juice.

Plans - Further work on grape juice powder will deal with developing simpler continuous procedures for manufacture.

Applications of the method for producing fruit juice powders by puff drying in a vacuum system has been extended to Concord grape juice during the past year at the Western Utilization Research Branch. In this method, volatile flavors are removed from grape juice prior to concentration. Stripped or essence-free juice is depectinized and concentrated to about 65°Brix under conditions that result in no changes in color or flavor. Concentrate is dried to about 3 percent moisture in a vacuum shelf drier in such a way that a puffed type of structure is obtained. Extremely rapid solution in water (5-10 seconds) is assured as particles are disc-like in shape and very thin in cross-section. Volatile flavors are returned to the completed powder by adding to each can of powder the proper amount of essence recovered from the single-strength juice, and an internal desiccant added to further lower the moisture content of the product. Flavors are returned in the form of a coarse powder made by transferring the volatile flavors from water solution (concentrated essence) into an edible oil solution and dispersing the oil solution throughout a solid carrier such as dextrose or common sugar. Products obtained by this method are indistinguishable in flavor from the original single strength juice.

Plans - It is planned to continue work on this project in regard to (a) determination of the most economical drying cycle for production of powder, (b) development of methods easily adaptable to commercial equipment for transferring volatile flavors from water to edible oil solution, and (c) determination of storage stability of these powders at various moisture levels and at various temperatures encountered in civilian and military usage.

PLUM JUICE CONCENTRATE - WU

Progress and Findings - Work has been started at the Western Utilization Research Branch on finding new types of products made from plums. In common with certain other fruits, growers of plums have been faced with serious problems in the disposal of their crops due to a static market and increased crop yields resulting from improved cultural practices.

The first step in this program has been to initiate studies, in co-operation with the California Tree Fruit Agreement, of the potentialities of juice and juice concentrates as additional outlets for both cull and surplus fruit. This year, juice was made from three maturities (fresh market as usually shipped, fresh market after ripening in the laboratory, and tree ripened) of each of the 14 most important commercial varieties.

Comparison of these juices as to color, volatile ester content, type of flavor, tartness, and sweetness has shown that several of the varieties, notably Santa Rosa and Duarte, show promise for use as beverage bases, and as blending ingredients in fruit juices.

Plans - It is planned to continue work on juice from the more promising varieties as to suitability of various maturities, effective essence recovery, concentration without changes in color or flavor, storage stability of single strength and concentrated juice at various temperatures, and potential uses for these products.

SHELF LIFE OF CANNED APPLE AND GRAPE JUICE CONCENTRATES - WU

Progress and Findings - In this work, as reported last year by the Western Utilization Research Branch, 4-fold apple juice concentrate and grape juice concentrate were canned, commercially sterile by hot fill, and stored at 70°, 90° and 100°F., with and without prior holding at 40°F. or 0°F. Some samples have been kept for 18 months or two years, first at one of the lower temperatures for six months or one year, then at 70°F. or above for an equal time. Taste comparisons have been completed on part of these samples.

The apple and the grape juice concentrates held at 40°F. for 12-16 months showed a definite weakening of the natural flavors characteristic of the original material, as compared with samples of the same concentrate held at -30°F. for the same period. The reconstituted juice was described as "characterless, without noticeable off flavor." This was true for either cans or bottles.

At 70°F. these products did not show any important off-flavor development after six months. After 12 months' storage, there was a definite detectable change, slightly more in the apple than in the grape. However, for apple juice concentrate, the quality at 12 months was within the range of quality of single strength canned or bottled juices available on the local market. The commercial juices with low-off-flavor

had more "apple-juice flavor" than the concentrate held 12 months at 70°F., but in at least two samples of commercial juice there was an objectionable "incipient fermentation" flavor. At 90°F. the concentrates were good after 1 month, slightly changed at 3 months, and definitely off at 6 months. At 100°F., 3 months was sufficient to cause definite off-flavor. Again, the stored apple juice concentrates, with what were considered definite off-flavors, were judged to be as good as some single-strength apple juices on the market at the time. Caution must be used in interpretation of any such comparisons, however, since our laboratory taste panels have become used to one type of apple juice and are not in position to judge consumer reaction. It may be that the consumer will purchase apple juice with "robust" flavor, whether "cidery" or not, in preference to a product with little or no off-flavor, but weak in natural flavor.

For apple juice concentrate, it appears that prior holding at 40°F. for 6 months, before storage at 70°F. or above, did not cause any noticeable shift toward shorter shelf-life at the higher temperatures. This finding could have an important bearing applicable to the marketing or military holding of the product. Further cross-comparisons to verify this are planned, both for prior storage for 6 months and 12 months at 40°F.

Prior holding at 0°F. for 6 months did not appear to affect subsequent storage life at higher temperatures. This would be expected.

Plans - This work is to be finished this year with completion of the taste tests.

STORAGE QUALITY OF CONCENTRATED APPLE JUICE - EU

Progress and Findings - Investigations were continued at the Eastern Utilization Research Branch on the improvement of the quality of stored apple juice concentrates by various treatments of the juice prior to concentration. Full-flavor 68-60° Brix apple juice concentrates were stored at 5°, 25°, and 37.8° C. (41°, 77°, and 100°F.). Measurements of the color density were made periodically for periods up to a year. The effects of the following treatments of the juices before concentration on the darkening of the concentrates were determined: Ion-exchange, light, lack of air space, decolorization with carbon, and the addition of essence, bisulfite, and amino acids. The treatment most effective in reducing darkening, particularly at low and medium temperatures, was successive treatment with cation- and anion-exchange materials, followed by restoration of the organic acid content and pH adjustment.

Plans - This line of work will be discontinued in view of the improved stability of superconcentrated apple juice reported below.

Publications

Apple Juice from Superconcentrate Is Preferred, R. K. Eskew, G. W. Macpherson Phillips, and N. C. Aceto, Glass Packer, Vol. 33, No. 3, pp. 37, 68, March 1954.

Powder Makes A-1 Apple Juice, Howard I. Sinnamon, Victor A. Turkot, Roderick K. Eskew, and G. W. Macpherson Phillips, Food Engineering, Vol. 26, No. 7, pp. 78, 79, 131, 132, July 1954.

STORAGE OF SUPERCONCENTRATED APPLE JUICE - EU

Progress and Findings - Storage tests have been completed at the Eastern Utilization Research Branch on superconcentrated (7-fold) full-flavor concentrated apple juice at 73° and 100°F. These showed that if hot packed in the conventional way in double coated enameled seam striped cans the product stands up well for upwards of a year at 73°F. This is important in that it enables the concentrate to be marketed through ordinary channels without refrigeration. Shelf life at 100°F. was about 2 months.

Plans - No further studies are contemplated on superconcentrated apple juice.

APPLE JUICE POWDER - EU

Progress and Findings - It has now been shown that powdered apple juice prepared similarly to powdered grape juice can be stored for at least 6 months at 100°F. with good retention of flavor if an inpackaged desiccant is used and the material is preconditioned as is done with powdered orange juice.

Plans - Further work on apple juice powder will deal with developing simpler continuous procedures for manufacture.

CONSUMER TEST ON APPLE SUPERCONCENTRATE - EU

Progress and Findings - Through the cooperation of a large food manufacturer, single strength bottled juice and reconstituted juice from full-flavor superconcentrate were evaluated by volunteer tasters in two New York department stores. Among the 375 tasters it was found that for every person who preferred the single strength bottled juice 1.6 persons preferred the juice made from the superconcentrate. In the opinion of a representative of a large food manufacturing organization, "This is a relatively high preference for this type of test and indicates a very real difference in acceptability." The recorded comments showed that where the concentrate was preferred it was generally on some basis such as "more flavor", "better flavor", "more apple flavor", or "more natural flavor."

It appears from this test, at least as far as the Metropolitan New York area is concerned, that the public prefers the fresh apple flavor of juice reconstituted from a full-flavor superconcentrate to single strength bottled juice. This preference is based on flavor and does not take into consideration the additional advantages of a superconcentrate such as compactness and convenience.

ESSENCE FORTIFIED APPLE SAUCE - EU

Progress and Findings - Studies on the improvement of apple sauce quality by the addition of apple essence were continued in cooperation with Knouse Foods Cooperative, Inc. Last year's work on freshly canned sauce indicated that quality improvement was detectable in products fortified with 1-1/4-fold peel and core essence and 0.1 and 0.2 percent citric acid. After storage for 9 months the fortified samples were still rated above the controls by both trained and consumer panels. Some flavor loss was indicated by the fact that the overall ratings were lower than before storage. This investigation has demonstrated that the quality of canned apple sauce can be improved by the addition of essence and citric acid and that this quality improvement is largely retained by a season's pack.

Plans - This work has been completed.

PEACH JUICE CONCENTRATE - WU

Progress and Findings - Methods have been worked out at the Western Utilization Research Branch for the preparation of various types of peach juice from fresh freestone and clingstone peaches which involve blanching and pureeing of peaches, treatment of puree with pectinol, and separation of juice by pressing. Various types of juice obtainable by these methods are being compared as to flavor and as to total ester content. Essence recovery and concentration studies have been initiated on each of these types of juices.

Plans - It is planned to continue essence recovery and concentration studies on the most promising of these juices and to determine such factors as the economic degree of evaporation for essence recovery, maximum pressures at which concentration may be carried out without discernable changes in flavor or color due to temperatures existing in the concentrator, and stability of single strength and concentrated juices at various temperatures. Studies will be instituted as to the suitability of products for use in the preparation of beverages, sherbet, jelly and other uses.

PEACH AND APRICOT PUREE CONCENTRATES - WU

Progress and Findings - Further studies on concentration of peach and apricot purees have been carried out during the past year at the Western Utilization Research Branch. The work has been concerned principally with development of methods for comparison of the reconstituted product with the original material in order that damage to the product as a result of concentration may be measured. An exhaustive study of consistency changes in these and other purees due to changes in concentration was carried out by measuring force-flow characteristics with a Stormer viscometer.

The information obtained has been used to show that purees can be concentrated in small laboratory equipment and reconstituted without altering discernibly the force-flow characteristics of the material. Such a finding will permit material acceleration in any development program of these juices.

Plans - It is planned to continue work on these purees, particularly in regard to efficient methods in commercially obtainable equipment for producing the high quality product that has been obtained in small laboratory equipment. Stability studies of these products, both hot pack and frozen, will be instituted upon completion of processing studies.

EXTENSION OF CONCENTRATE STUDIES TO NEW FRUITS - EU

Progress and Findings - There is an increasing tendency on the part of jelly manufacturers to use full-flavor concentrates instead of single strength juices. The former avoids boiling thereby shortening the process and yielding jellies with better fruit flavor. The full-flavor concentrates are also of value to the flavoring extract industry, since they contain substantially all of the fruit aroma.

Strawberry: Satisfactory full-flavor concentrates were prepared from the juice of Eastern-grown Blakemore strawberries. Two products were developed: A 50° Brix frozen concentrate aimed at the jelly trade and a 68° Brix concentrate for use in ice cream, sherbets, beverages, and other food products. Both concentrates, when reconstituted, compared very favorably in flavor with the fresh juice. A brightening of the red color, inherent in the processing of the juice, is expected to appeal to the jelly industry in particular, since it should impart a richer color to the final product; usually strawberry-apple jelly.

Plans - Future work will include studies on juice of the other important eastern strawberry, the Premier.

Blackberry: A full-flavor concentrate was prepared from the juice of Eastern-grown blackberries. The concentrate, when reconstituted, was found by a trained taste panel to be substantially equal to the fresh juice. The process consists essentially of vaporizing 40 percent by volume of the juice at atmospheric pressure and concentrating the aroma to a high fold essence in the conventional way. The stripped juice is depectinized, clarified by filtration and then concentrated to a high density at a temperature of 110° to 115°F. Essence is then returned to the stripped juice concentrate in the proper proportion.

This work was done in cooperation with a large producer of fruit juices for the jelly trade. They tested the full-flavor concentrate and found it entirely satisfactory.

METHODS FOR THE INCORPORATION OF NATURAL FRUIT FLAVORS WITH FRUIT POWDERS - WU

Progress and Findings - An important part of the natural flavoring material in fruit juices is volatilized when the juice is concentrated and dehydrated to a powder. To provide satisfactory flavor in fruit juice powders, two problems are involved: first, to recover the volatile aromatic components (essence) and to reduce it to a water-free concentrate; and second, to incorporate this concentrate in an edible solid carrier

which will protect it from oxidation and volatilization and afford rapid dispersion of the flavoring material when the fruit juice is reconstituted. With citrus fruits, recovery and concentration of essence is unnecessary because the peel oils have been found to be satisfactory flavoring agents and can be sealed in solid carriers directly.

Concord grape essence has been incorporated, experimentally, into a solid carrier at the Western Utilization Research Branch. This was accomplished by concentrating the volatile flavor to 33-fold in a pilot plant essence recovery system, concentrating to 330-fold in a laboratory fractionating column, extending the essence in a bland vegetable oil by means of an extraction step, then incorporating the oil solution of essence in a solid carrier. Organoleptic tests have shown that very little change in the quality of flavor occurred during the preparation of this product.

In connection with the development of orange juice powder at this Laboratory, sorbitol has been used as the solid carrier for orange oil. Sorbitol is satisfactory in many respects, but its usefulness appears to be limited to a certain crystalline form which is not always obtained in practice. The common sugars, sucrose and dextrose, have been found to be quite promising as carriers for flavoring oils, provided the final product can be kept dry. When exposed to a moist atmosphere, the sugars change from an amorphous to a crystalline state, developing numerous cracks through which oil can escape or oxygen can enter. Some further protection against crystallization is provided by addition of corn sirup solids to the sugar before melting and emulsifying with the flavoring oil. A limited study with samples of orange oil "locked" in dextrose and in sucrose is in progress. During three months at 100°F. there was no significant loss of oil or change in flavor as determined by analytical and organoleptic tests. Results were essentially the same as for samples of orange oil locked in sorbitol.

Plans - Further experiments with dextrose and sucrose are in progress, aimed at achieving higher concentrations of flavoring oil, lower temperatures for the emulsification step, and lower loss of flavoring material during preparation. The best solution to the first and last of these problems would appear to be in development of special mixing and pelleting equipment, which is now under consideration. It is planned to extend this work to include, in addition to the common citrus fruit juices, the volatile flavoring components of grape, apple, and pineapple.

SINGLE-PASS ATMOSPHERIC CONCENTRATION OF FRUIT JUICES - EU

Progress and Findings - Efforts to find simpler and cheaper methods for preparing fruit juice concentrates have resulted in the development of a process wherein depectinized fruit juice is fully concentrated at atmospheric pressure in a few seconds with simultaneous recovery of essence. In the conventional process essences are recovered from the juice by merely vaporizing 10 to 40 percent (depending on the type of fruit) in order to release aroma. The stripped juice is then concentrated under vacuum. In the new process which has been termed SPAC (single pass atmospheric concentration), the juice is first depectinized. It is then passed through an essence recovery unit so designed that concentration can be carried to 7- or more fold in a single pass. This entails vaporizing upwards of 80 percent by volume of the juice. With proper engineering design this can be accomplished by indirect heating in a few seconds without damage to the juice or dilution by injected steam. All of the vapors pass to the fractionating column and are concentrated to essence in the usual way. Furthermore, the essence in the case of certain fruits, for example, grape, will in the new process contain more of the aromatic juice constituents than would be the case if only the conventional 30 percent were vaporized. In order to effectively recover the more completely stripped aroma, improvements in column design will be required. Fundamental studies on the fate of important constituents in aroma are now being made to permit such improved design. SPAC will eliminate the necessity for a vacuum evaporator and one operator can control both essence recovery and juice concentration. The process has thus far been tested on grape and blackberry juices successfully. Perhaps the greatest value of the simplified procedure will be with grape juice. Feasibility of simultaneous de-tartration and depectinization has been demonstrated commercially. By combining this procedure with SPAC the advantages are obvious.

Plans - It will be tested on other fruits as rapidly as work permits.

RATE OF CRYSTALLIZATION OF SPRAY-DRIED SUCROSE - WU

Progress and Findings - In order to obtain information necessary for an understanding of the storage stability of sugar-rich spray-dried fruit powder and fruit purees, an investigation of the rate of crystallization of spray-dried sucrose at several relative humidities between 5% and 32.5% has been continued at the Western Utilization Research Branch. During the past year the data obtained on the rate of crystallization of amorphous sucrose at several humidities have been mathematically analyzed.

In cooperation with Prof. H. M. Hughes of the University of California, an equation has been derived which accounts in a very satisfactory manner for the crystallization behavior of amorphous sucrose stored undisturbed at a constant relative humidity. This rate equation provides an insight into the mechanism of crystallization and will enable a quantitative study to be made of the crystallization behavior of amorphous sugars in spray-dried food products.

Plans - It is planned to complete this project by the end of the current year.

LOW MOISTURE RSP. CHERRIES - WU

Progress and Findings - Studies have been undertaken at the Western Utilization Research Branch to develop low moisture (less than 5%) dehydrated cherries for use as pie stock. Preliminary experiments have shown that use of low moisture cherries as a pie material yielded pies that were both attractive in color and surprisingly strong in cherry flavor. As compared with pies made from water-packed cherries, those made from low moisture cherries were definitely superior in both color and flavor. In comparison with pies made from conventionally frozen cherries, they were somewhat firmer in texture and weaker in flavor. The chief problem with this product appears to be that of storage stability. As the raw material for manufacture of this product would undoubtedly be frozen cherries, a series of experimental packs have been put up to determine the effect of various treatments and additives prior to freezing or prior to drying upon the storage stability of the product.

Plans - It is intended to prepare samples of low moisture cherries from the experimental packs mentioned above and to determine the relation between these pre-drying treatments and the stability of the product in order to obtain a suitable product.

DEHYDROFROZEN APPLES - WU

Progress and Findings - Trial packs of dehydrofrozen apple slices were put up by two commercial packers during the past year. An eastern concern packed three varieties (Rhode Island Greening, Baldwin and Northern Spy). An observer from the Western Utilization Research Branch was present during the first week of the pack. Based upon the quality of samples forwarded to the WURB when made into pies, the quality of the products was equal to that of samples prepared from Western fruit in this Laboratory. A California concern packed

approximately 30,000 pounds of dehydrofrozen Newton Pippin apples. Under an Informal Memorandum of Understanding, an experimental rotary drier designed by the WURB (See p. 108) was used in dehydrating the slices and the run carried out with the advisory assistance of WURB personnel. Appraisal of samples likewise showed that the quality was similar to that obtained with the laboratory prepared product.

The dehydrofrozen apples from both sources were purchased in part by a large bakery chain and tested under conditions such as would be used in their bakeries. The product was described as generally satisfactory for use in pies, although several problems in preparing and baking procedure were encountered. Full information on these problems is being obtained, in order to determine what needs to be done to get pies under all conditions of bakery practice that are of the same high quality obtained in the laboratory and in earlier small scale bakery trials.

Plans - Active research work on the preparation of dehydrofrozen apples has been completed. Further work on rehydration methods, drying equipment, modifications of the process, and supplying information to processors and bakers will be undertaken as needed.

DEHYDROFROZEN APRICOTS - WU

Progress and Findings - Further progress can be reported on commercial adaptation of the Western Utilization Research Branch method for making dehydrofrozen apricots. Appraisal of the product for use in making preserves, which is one of the principal outlets for this commodity, by a large Eastern Company (reported last year) resulted in the placement last summer of a trial order for 7,000 pounds of product for expanded tests by this concern. The pack was prepared by a commercial dehydrator under WURB supervision in a commercial prune drying tunnel.

The chief advantage resulting from use of dehydrofrozen apricots in preserve manufacture (other than savings in manufacture, storage and shipment of the dehydrofrozen apricots) lies in the superior quality of preserves which may be prepared. Dicing of the apricots to the desired size before thawing permits control of piece size in the preserves. As it is necessary to add rather than to boil off water during preserve preparation, a brighter color and more natural flavor is obtained.

Plans - Active research work on the preparation of dehydrofrozen apricots has been completed. It is planned to continue work on methods of preserve manufacture from this product, on supplying prospective packers with information and advice on processing methods, and on the use of this product in pie manufacture.

DEHYDROFROZEN RED SOUR CHERRIES - WU

Progress and Findings - Research on the preparation of dehydrofrozen red sour pitted cherries has been continued at the Western Utilization Research Branch. Experiments have shown that improved processing procedures yield dehydrofrozen cherries which can be made into pies of good quality. The color and flavor of the cherries in the pies approached that in pies made from frozen cherries and were considered superior to those made from canned pie pack cherries. Occasional problems of failure to regain full plumpness during rehydration were found, but it is believed that this can be worked out with further research on processing and pie-making procedures.

Plans - It is planned to continue the investigation of pre-drying treatments and drying conditions in order to work out the possible variations which may be used in preparing the product. Pie-making procedures also will be worked upon.

NEW DRIER FOR DEHYDROFROZEN APPLES - WU

Progress and Findings - In recent work at the Western Utilization Research Branch directed toward the development of practical procedures for commercial production of dehydrofrozen apple slices, a new type of through-flow rotary drier, originally developed by Branch engineers for use in the dehydrocanning process, was modified to meet the special needs of the dehydrofreezing process. The drier is a semi-commercial scale unit designed for operation in a continuous processing line. During the 1953 apple season, the drier was installed in a cooperating commercial processing plant at Watsonville, California, and used successfully in the production of approximately 30,000 pounds of dehydrofrozen Newton Pippin apple slices from 60,000 pounds of fresh apple slices, equivalent to approximately 100,000 pounds of whole apples. The bulk of the production was purchased by a national bakery for field trials as apple pie stock. The remainder of the pack is being distributed by the packer to other consumers. The successful demonstration of the new drier in this production operation will encourage more rapid acceptance of the dehydrofreezing process. The design of a practical commercial drier now appears to be feasible.

Plans - It is planned to conduct similar tests with other interested concerns and to prepare design drawings for commercial-scale driers in order to facilitate commercial development.

Publications

"New through-flow rotary drier for the partial drying of apple slices," W. C. Rockwell, E. Lowe, G. S. Smith, and M. J. Powers. Presented at National IFT meeting, Los Angeles, California, June 29, 1954. (To be published in Food Technology.)

DEHYDROCANNED APPLES - WU

Progress and Findings - Experiments designed to improve the quality of dehydrocanned apples after storage for extended periods of time at 70°F. have been instituted at Western Utilization Research Branch. Although it is possible to pack this product in such a manner as to prevent color and flavor deterioration over a period of one year, inconsistent results within a variety of apple and differences in results between different varieties indicated a need for a more thorough study of the factors involved. Active research work on development of a product to meet military needs (storage at 100°F.) has been deferred until such time as more fundamental information on the deteriorative reactions involved becomes available.

Plans - It is planned to continue work in the development of a dehydrocanned product that will maintain initial quality under conditions of civilian usage (at least one year at 70°F.).

DEHYDROCANNED APRICOTS - WU

Progress and Findings - Active research work on this project has been terminated due to the inherent instability of dehydrocanned apricots. Such products, over the range of 30 to 70 percent weight reduction, were of excellent initial quality, but deteriorated noticeably during storage at room temperature and at a fairly rapid rate at elevated temperatures. These changes consisted both of darkening and of loss in texture in the product. Under the most severe conditions studied -- 70 percent weight reduction and storage for 6 months at 100°F. -- a marked darkening of the apricots had occurred and the flesh had disintegrated to a mushy, pasty mass.

Plans - These studies have been terminated.

DEVELOPMENT OF LOW-MOISTURE PEACHES - WU

Progress and Findings - Work on this problem has been continued, using as raw material both fresh fruit and commercially sun-dried fruit. Fresh fruit gives a superior dehydrated product, but the bulk density is lower and dehydration must be done soon after harvest. A vacuum shelf drier was used in all cases.

An extensive storage study on low-moisture Elberta, Halford, and Rio Oso Gem peaches, dehydrated directly from the fresh state, has been completed. Best results were obtained with Elbertas, which were dried to 0.4-0.8% moisture in 21 hours after dipping in dilute sulfur dioxide solution for two minutes. The sulfur dioxide content of the dried product was less than 400 p.p.m. After storage in vacuum packed cans for six months at 100°F. and reconstitution, the product could scarcely be distinguished from the control samples (stored at -30°F.), by the taste panel. Color and texture were good. Rehydration was accomplished by cooking one minute, without any presoaking. There is evidence to support the belief that drying time can be materially decreased if in-package desiccation is used.

The dehydration rate for further drying of sun-dried peaches (to about 2.5% moisture) has been accelerated by briefly steaming the fruit, in the absence of air, in the chamber of the vacuum drier. Moisture contents of 6%, 4%, and 2.4% were attained in 4.5, 7, and 22 hours, respectively. The best cooking procedure was to boil 5 minutes, preferably after soaking for 2 hours. A comprehensive storage study of products of this type is in progress. The data obtained to date confirm earlier findings that stability at 100°F. is greatly improved at the lower moisture levels.

Plans - The present storage study will be completed during 1954-1955 and complete reports of the findings will be prepared for publication.

P. Proposal for Committee Consideration

Expand and where necessary initiate new lines of research and development of concentrated liquid and solid form fruit products. These should include concentrated juices and purees, fruit dried in piece form (either whole or sliced), and fruit powders with emphasis on development of cheaper continuous processes. Concentrated fruit juices, purees, and powders are assuming great commercial importance as a means of making a wide variety of fruit products available to the public throughout the year at a reasonable price. However, much additional information is needed if continued progress in expansion of the market for concentrated fruit products is to be realized. More

information is needed on factors affecting stability of concentrates and means of increasing their shelf-life at above-freezing temperatures. Aseptic canning, and sterilization by means of high-velocity electrons which permit pasteurization with minimum heat treatments, offer promise in this field and should be investigated. Potentialities of different methods of concentrating should be evaluated. For example, investigations should be made of freeze concentration of juices, including evaluation of present freeze concentration procedures, development of new and improved processing methods, and estimation of processing costs. Concentration by removing water in the form of ice offers a means of concentrating heat sensitive products without causing undesirable changes in color and flavor. Vacuum drying procedures should be further explored as another means of concentrating heat-sensitive fruit products so that they can be produced in quantity and at prices that would assure their sale in domestic or foreign markets. Investigations on powders should include: (1) comprehensive stability studies using in-package desiccants; (2) development of procedures for concentrating and stabilizing volatile flavors, and (3) development of improved and less expensive equipment for preparing vacuum-dried powders.

. Expand fundamental engineering studies on the design of fractionating columns used in essence recovery. Current designs are based on limited empirical data and are known to be inefficient for the recovery of some important flavor components in grape, cherry, and other fruit juices.

BLENDED FRUIT JUICES

Progress and Findings - 1954 Recommendation - "Initiate research to develop a blend or blends of fruit juices that will be more acceptable than either of the component juices in order to increase over-all consumption of fruit." (5/12)

Resources did not permit the initiation of such research.

. Proposal for Committee Consideration - Initiate research to develop a blend or blends of fruit juices that will be more acceptable than either of the component juices in order to increase over-all consumption of fruits. The popularity of blends of vegetable juices indicates the potential market for such products. At this time no analogous fruit products have been widely accepted and very little study has been made of blends of various fruit juices. Special attention should be given to the use of tropical and sub-tropical fruits in these blends.

TENDERIZING TREATMENT OF CANNED ITALIAN PRUNES - WU

Progress and Findings - Studies on modification of the skin texture of canned Italian prunes were continued by the Prosser Laboratory. The role of calcium in the skin texture of this product, described in the previous report, was confirmed. The addition of calcium to the canning sirup increased the toughness of the skins of the canned fruit and the increase in toughness was proportional to the amount of calcium added. The same toughening effect was observed when hard water from various sources was used in preparing canning sirups. The effect of such water was limited to its calcium content since magnesium, another common constituent of hard water, was found to have no effect on skin texture.

Addition of sodium hexametaphosphate, a calcium sequestering agent commonly used to soften water, caused a tenderizing of the skin, presumably through its ability to stabilize calcium in a soluble form. The degree of tenderizing was found to be proportional to the amount of sodium hexametaphosphate added. This tenderizing action was accomplished without detracting from the flavor, color, or general appearance of the product. The process therefore provides a simple, inexpensive method by which canners can control the skin texture of canned prunes. The amount of sodium hexametaphosphate used can be varied to give a skin texture considered most desirable, thus compensating for natural differences in skin texture observed among different lots of prunes within a growing area, for variations between prunes from different growing areas, and for differences observed from season to season. The concentration of sodium hexametaphosphate in the canning sirup would range from $\frac{1}{4}$ to 1%. The pea tenderometer, when suitably adjusted, was found to provide a useful objective measure of skin texture in the canned fruit, and its use would permit accurate standardization of this quality.

The addition of citric acid to the canning sirup was also found to cause a tenderizing of the skins of canned prunes. This treatment, while causing an undesirable increase in acidity in the Italian varieties, may have special application in low-acid varieties such as Stanley.

Plans - These studies will be continued during the 1954 season to obtain further information on the use of organic acids as a tenderizing agent. The effect of various treatments on the skin texture of canned apricots will also be studied.

BLUEBERRY PRODUCTS - WU

Progress and Findings - Blueberries in the Pacific Northwest have been marketed chiefly on the fresh market. Expanding acreage is creating some demand for outlets for blueberries in the processed form. In cooperation with the Departments of Horticulture and Home Economics of the State College of Washington, some work has been done on developing formulae for blueberry products and on comparison of varieties in processed products. The Jersey variety of blueberry was preferred in the frozen dessert pack and in the form of pie. Blueberries frozen in 45% sugar sirup were preferred over berries frozen in a lighter sirup. Mixtures of blueberries and cranberries in pastry products and frozen spreads were very well received. Experimental packs of canned blueberries in which two or three varieties are blended have been put up to be examined later in the year.

Plans - Further experimentation with blueberry products and comparison of varieties is planned for next season.

UTILIZATION AND DISPOSAL OF BY-PRODUCTS AND WASTES

SMALL SCALE FRUIT WASTE UTILIZATION - WU

Progress and Findings - 1954 Recommendation "Expand research on fruit waste utilization for the purpose of making the salvage operation applicable on a smaller scale, particularly in individual canneries." (11/12)

Resources available did not permit further development work at the Western Utilization Research Branch during the past year on modification of the pear waste utilization process to make it economically applicable in individual canneries.

Publication

"Recovery of sugars from pear-canning waste." A. M. Neubert, D. W. Graham, Jack L. Henry, J. E. Brekke, and C. L. Beardsley, Agric. and Food Chem. 2, 30, 1954.

GROUND NUT SHELLS AND FRUIT PITS AS CLEANING AND POLISHING AGENTS - NU

Progress and Findings - Commercial nut crackers and shell processors have continued to request information regarding means of processing nut shells and fruit pits and applications for the ground products. As a result, at least two new plants grinding nut shells for industrial purposes have been established -- one at Stockton, Missouri and one at Cornelius, Oregon. Shells of some nuts and fruit pits have been investigated as abrasive agents for deburring, cleaning, burnishing, and polishing oxidized steel stampings by tumbling barrel methods. Grits from hard shells, e.g., black walnuts and apricot pits, while effective in removing oxide scale, failed to polish satisfactorily because of fine scratching of the metal surfaces.

Plans - Work on the use of ground nut shells and fruit pits as cleaning and polishing agents is being continued.

- S. Proposal for Committee Consideration - Initiate research on the development of uses for pecan shells, now a waste product and a disposal problem. Investigate approaches to this problem which will take advantage of the chemical composition of the pecan shells, e.g., their tannin content as well as a more general approach suitable to all agricultural residues to obtain new and useful chemicals. . .

B.. Proposals for Committee Consideration

UTILIZATION RESEARCH

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F. Expand research on the kind and quantities of constituents of fruits and nuts.	68
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M. Expand research to develop better methods for manufacture of improved dried prune products.	80
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III MARKETING RESEARCH

CHITTAGONG DISTRICT

A. Progress on Work Under Way

MARKET ORGANIZATION AND COSTS

MARKETING OF TREE NUTS - MRD

Progress and Findings - 1954 Recommendation, "Initiate a study to (1) measure the market potentials for nut meats used by bakers, other food processors, and consumers, (2) determine patterns of consumer use and acceptance for tree nuts and nut meats, and (3) determine the competitive position of domestically produced nuts." (10/25)*

There is being initiated during the current fiscal year a study relating to the marketing of pecans, walnuts, almonds and filberts that will provide some of the information required in evaluating the competitive position of domestically-produced tree nuts. This work will be a prelude to more intensive studies of the margins, costs and efficiency in marketing each of the four major tree nut crops produced in the U. S. Competition between each of the domestic tree nuts and other commodities, both imported and domestic in origin, will be a phase of the more intensive investigations. Effects of marketing agreement programs will also be considered.

Most of the data required in the initial phase of this study is expected to be available from sources within the Department. Field investigations will be used to supplement the secondary sources of information.

Because of the comparatively high cost of carrying out national surveys of consumers and food processors relating to preferences and use patterns, no work has been started on this phase of the project.

Plans - The work will be continued on substantially the same level after June 1955 when emphasis will be shifted from the general economics of marketing tree nuts to the marketing process through which the individual tree nut crops are moved into consumption. It is planned that filberts will be the first commodity to be considered on the more intensive basis.

No work on consumer preference and use patterns is planned at this time. However, if similar work relating to peanuts and peanut products is undertaken, certain of the competitive factors affecting tree nuts would be studied.

Proposal for Committee Consideration - Initiate a study to determine the patterns of consumer uses and preferences for tree nuts and nut meats.

* 10/25 means tenth in priority of twenty-five recommendations of 1954 in Marketing Research.

COORDINATING THE MARKETING OF FRUITS AND VEGETABLES - FCS

Progress and Findings - 1954 Recommendation "Expand studies directed towards the development of coordinated marketing programs for deciduous fruits and vegetables." (16/25)

Work has been initiated with one full-time professional worker assembling information on buying and selling practices from the retail and wholesale trade in several markets. The study is designed to assist small and medium-sized processors and shippers in developing more effective sales and merchandising methods and outlets by providing factual information on distribution methods, practices and costs.

Plans - The first phase of this work will cover the more important processed products. It is estimated that this study should continue for a minimum of two more years.

COSTS OF MARKETING DECIDUOUS FRUITS - MRD

Progress and Findings - 1954 Recommendation, "Expand studies to determine the comparative returns to growers and shippers of marketing peaches of varying degrees of maturity." (18/25)

Limitation of personnel did not permit an expansion in this line of work.

In July 1954 the packinghouse operations, including hydrocooling, of a selected group of peach growers and shippers in North and South Carolina were observed. Costs of labor and materials were recorded at each plant. Additional information on sales returns, selling costs, and overhead expenses on the peaches packed during the observation periods is being assembled. This study was intended as a pilot in the process of establishing a practical procedure for determining comparative returns to growers. A report on the 1954 work is expected to be ready early in 1955. In conducting the 1954 work on the marketing of southeastern peaches there was close cooperation with the North Carolina Agricultural Experiment Station which was carrying on a study of the economics of hydrocooling this fruit. The Agricultural Marketing Service study has been designed to supplement the investigation of the hydrocooling process by the State College. This approach to evaluation of the cooling process was suggested in the proposal submitted for committee consideration at the 1954 meeting.

Plans - During the next two seasons studies on a scale comparable to that maintained in 1953 and 1954 will be made in the mid-western and western peach producing areas. In these investigations the major emphasis will be on packing, shipping and selling costs. Maturity as a factor in determining grower returns will be isolated whenever that procedure is practicable. Experiment Stations in other important peach producing areas will be encouraged to follow the example of North Carolina in considering the costs and benefits of hydrocooling and the relationship of the process to the quality of fruit reaching the consumer.

- B. Proposal for Committee Consideration - Initiate a study of the packing, storage, transportation and selling costs of winter pears produced in Oregon, Washington and California, and of fresh prunes produced in Oregon, Idaho and Washington. There has been considerable industry interest in the early inauguration of such a study.

Publications

A preliminary report entitled "Marketing South Carolina Peaches in New York City, 1953" was prepared by William N. Garrott. This draft was released in January 1954 for administrative use only.

COSTS OF ALTERNATIVE METHODS OF PACKING PENNSYLVANIA APPLES -
MRD, Pennsylvania A.E.S.

Progress and Findings - 1954 Recommendation, "Initiate a study to improve Eastern apple handling methods." (21/25)

A report on the cost of alternative methods of packing apples has been prepared by the Pennsylvania Agricultural Experiment Station as a result of this cooperative project. This report based on field observations last year in 12 southern Pennsylvania packing houses indicates that apples packed in western boxes brought growers a higher rate of return than did similar fruit packed in bushel baskets.

The study is being expanded this year to cover additional production areas, but the objective remains the same; i.e., measuring the effect on grower returns of alternative methods of packing. From 20 to 30 packinghouses located in several counties of Pennsylvania are being included in the current observations. Particular attention is being given to costs of packing apples in consumer packages as well as in wholesale containers.

Plans - During the next fiscal year the analysis of data relating to the current observations will be completed and the report prepared for publication by Pennsylvania State University. AMS will cooperate in bringing the present study to completion but no definite plans have been formulated beyond that point.

Publications

Effects of Methods of Packaging Apples on Returns to Growers, Pennsylvania, 1953. W. A. Lee and W. M. Carroll, Pennsylvania Agricultural Experiment Station. In process.

Which Apple Pack is Best? W. A. Lee and W. M. Carroll, Pennsylvania Agricultural Experiment Station. Mimeographed report, 1954. This preliminary report has been quoted in a number of articles appearing in industry publications and trade newsletters.

IMPROVEMENT IN RURAL MARKETING SERVICES - FCS

Progress and Findings - 1953 Recommendation "Initiate cooperative studies for the development and improvement of marketing agencies handling fresh fruits and vegetables in production areas near consuming centers." (24/25)

Funds were not provided for the initiation of this work.

- C. Proposal for Committee Consideration - Initiate studies for the development and improvement of marketing agencies handling fresh fruits and vegetables in areas near consuming centers. These studies should analyze the experience and operation of rural marketing agencies that are rendering effective service to growers so as to determine which types of organizations or what modification of existing marketing agencies should be generally encouraged. For example, many growers are finding it necessary to develop plans to modernize marketing methods because farm packing has not brought about the quality pack and uniform grade that are sought by retailers and consumers. Producers also are finding it necessary to develop at the local market sufficient volume and adequate facilities to meet the requirements of large-quantity buyers. Research into the best ways of developing these operations is desirable so that both producers and shippers have available to them information on methods of operation, costs, volume requirements, and other factors that will bring about sound business organizations.

This proposed work is a major item in scope and would include several coordinated studies in selected fruit and vegetable procuring areas. Several State and local groups have expressed interest in cooperating in studies of this problem.

ANALYSIS OF FRUIT AND VEGETABLE MARKETING IN A CONSUMING AREA - Matching Funds (OES)

Progress and Findings - Major effort was directed toward carrying out the second and final experiment in development of a method of reporting prices of McIntosh apples at country points. This work was similar to last year's but changes and improvements were made. Growers were supplied each week with reporting blanks, on which they recorded sales data. The reports were returned for transcription and analysis, and then were returned to the growers for disposal. With each week's supply of blank forms was included a summary of price and sales information for use by the growers taking part in the study. Records were kept of prices reported by authorized price reporting agencies. Growers have expressed orally and in writing their appreciation for the value they have found in the weekly price summary.

At the end of the first season's experiment, a report was prepared on the work and distributed to growers participating. Transcription and analysis is continuing and a report on the two year experiment is in the planning stage.

Work was also carried on simultaneously on the phase of the general study having to do with the effects of the supermarket on the distribution of fruits and vegetables.

Plans - The supermarket phase of the general study will be completed.

Publication

McIntosh Apple Price Reporting at Country Points, 1952-53 Season. _____. Mimeographed report distributed to growers.

FACTORS AFFECTING SALES OF WESTERN DECIDUOUS FRUITS - MRD, Western Region (WM-2)

Progress and Findings - The objective of the study, which is one phase of the Western Regional Deciduous Fruit Project, is to determine the extent to which price, quality and certain merchandising factors affect the sales of apples and other fruits that are directly competitive. Data were collected in Denver, Colorado, during 1953 by representatives of the AMS and the Colorado Agricultural Experiment Station. Analysis of the data will be handled by the Washington State Agricultural Experiment Station but this phase of the work has not proceeded as rapidly as planned because of difficulties in obtaining personnel.

There is a reasonable probability that Washington State College will soon be able to obtain and assign to this project a qualified statistician who can proceed with summarization and interpretation of the accumulated data. In that event the analysis on which a report will be based should be completed before the end of the current fiscal year.

Plans - Cooperation of the AMS with the Regional Technical Committee will be continued. Preliminary suggestions for activating another phase of the project have been discussed with the Regional Technical Committee and will be undertaken as soon as the present study has been concluded.

COMPETITIVE POSITION OF FROZEN FRUITS AND VEGETABLES IN THE WESTERN STATES - MRD, Western Region (WM-17)

Progress and Findings - The Agricultural Marketing Service intends to cooperate actively in this work which is being initiated on a limited scale during the current fiscal year by state experiment stations in the western region. The AMS phase of this work which is now in the planning stage will probably emphasize the interregional aspects of the overall project and the effect on grower returns of marketing fruits and vegetables in the various forms, both fresh and processed.

Plans - Active cooperation with the Regional Technical Committee will be continued in developing and conducting this research.

Proposals for Committee Consideration

- D. Reactivate the study of costs of processing deciduous fruits and vegetables. A limited investigation of costs of canning and freezing certain fruits and vegetables was made by the Bureau of Agricultural Economics in 1949 and 1950. The data used in this project was obtained from individual firms and from public accountants who specialize in servicing processor accounts in several sections of the country. It is likely that the procedure used successfully in the earlier study can again be applied in assembling the information required in developing average cost figures for the industry on a national and regional basis. Another activity suggested for further checking as to practicability is the establishment of an index of major processing costs that would be computed on an annual basis. Such an index would be based in part on public information relating to average wage rates and materials costs but other data required for the index would necessarily be obtainable only from primary sources such as processors, supply houses, and accountants. This proposed study of processing costs would require the full-time services of one agricultural economist.

- E. Initiate work to compile information that will show changes in sources of supply, markets, and marketing services, channels, methods, and organization for deciduous fruits. This work also would be expected to show significant changes that have occurred in recent years in the marketing of fresh and processed deciduous fruits.
- F. Resume studies of the economic effects of Federal and State regulatory programs relating to the marketing of deciduous fruits and tree nuts on grower returns, industry development, market organization, competitive position, and marketing costs. A number of these programs have been in operation for a considerable period of years which should permit analysis of results in terms of grower returns and trends in the industries affected. Effects of these programs on the competitive position of the commodities covered would be a major phase of this study. Marketing programs of the regulatory type are concentrated in the Western States insofar as they apply to deciduous fruits and tree nuts. Winter pears and filberts would be possible starting points in the commodity-by-commodity description and analysis of marketing agreement programs. One professional worker would be assigned to this study. Much of the data required should be available from sources within the USDA.
- G. Initiate a study designed to measure the effect on shipping point prices of operating practices engaged in by various buyers in the local markets. It is generally believed that shipping point prices of deciduous fruits are to some extent influenced by the presence or absence of buyers both large and small and by their actions at any given time. The extent of this influence is not presently known. This study would be concentrated in a limited number of local market areas where a sizable volume of deciduous fruits is produced and offered for sale. It is believed that this study may provide at least partial explanation of some of the price fluctuations that occur so frequently in the marketing of fresh produce.
- H. Initiate studies with cooperatives and other processors for selected fruits and vegetables to determine the optimum use of processing plant, feasibility of introducing new product lines, market potential for various forms of processed products, and off-season use of plant and personnel. This study would analyze the actual vs. optimum use of plant facilities, the extent to which the use of the plant could be increased or combined with other operations, and the possibilities of processing commodities not being handled in current production. Representative plants would be studied to determine the feasibility of adding units of production in existing plants, changing commodity forms, or producing new commodity lines. Buyer preferences and the possibility of expanding outlets through development of secondary or non-competitive markets for processed commodities would be examined along with an

analysis of market potential and relative advantages of diversification of commodity lines, new product forms, can sizes, packages, and frozen vs. canned products. Development of off-season uses for processing plant facilities and personnel, such as warehousing and other business uses also would be studied.

MAINTENANCE AND EVALUATION OF PRODUCT QUALITY

PROTECTION OF DRIED FRUIT AND INSECT ATTACK - MRD

Progress and Findings - 1954 Recommendation, "Expand research that will lead to low-cost methods for control of storage insects of dried fruits and tree nuts." (2/25)

Lack of funds prevented expansion of this work.

Holding infested raisins in a vacuum in excess of 25.5 inches for 24 hours killed the larval, pupal, and adult stages of the saw-toothed grain beetle and the Indian-meal moth, the most common insects attacking raw raisin stocks. It required 48 hours in vacuum to kill all Indian-meal moth eggs. This information was developed to determine whether or not the vacuum packing process for raisins packed for the Army Quartermaster Corps could be utilized for insect control.

The Fresno station marshalled all facilities to assist the raisin industry to fumigate between January and May 1 all raw raisin stocks in storage awaiting processing, as the result of an agreement between the industry and the Food and Drug Administration. Methods of fumigating stacks of raw raisins under various types of covers, ranging from tarpaulins to laminated paper were demonstrated, and the mortality of insects and the gas distribution and concentration determined in test lots.

During the harvesting and drying period a special study was made in conjunction with the industry of the importance of raisin moth infestation as a source of insect fragments in processed raisins and methods by which such infestation can be minimized. Additional personnel was assigned to Fresno during this period for this purpose.

Plans - This work will be continued.

- I. Proposal for Committee Consideration. In view of the acute insect problem in stored raisins, it is proposed to expand the staff and facilities of the Fresno station to expedite studies on raisins, and to initiate studies on preventing insect infestation in tree nuts and nut meats in market channels.

Publications

The sources of insects found in stored raisins, prepared by the Fresno station. Processed and distributed by the Dried Fruit Association of California, July 1954.

INSECT CONTAMINATION OF PROCESSED FRUITS, BERRIES AND VEGETABLES - ENT

Progress and Findings - 1954 Recommendations, "Expand Cooperative Work With State Agencies on Insect Contamination Problems of Importance to the Processors of Fruits, Berries and Vegetables to Develop Methods for Their Solution." (3/25) Additional funds for expansion were not provided.

Research on the Drosophila (vinegar gnat) problem was continued. Although major efforts were directed against this insect in relation to tomatoes to be processed, attention was given to studies of methods for reducing its breeding in cull peaches.

Laboratory tests in Maryland and Utah showed that a poison bait prepared by saturating vermiculite with a water solution containing chlordane, molasses and yeast killed from 83 to 97 percent of the Drosophila adults confined in cages. Sprays containing 0.1 percent of chlordane, heptachlor, lindane, aldrin, dieldrin, isodrin, malathion, parathion, Bayer's L-13/59 or Cyanamid 12008 completely prevented the breeding of Drosophila in canned pumpkin under laboratory conditions. Heavy breeding occurred in all comparable untreated lots of pumpkin. A freshly prepared mixture of blackstrap molasses, ethyl alcohol, yeast and water was more effective as an attractant of the Drosophila adults in laboratory tests than a fermented mixture of unsulfured molasses and yeast, previously considered to be the most effective attractant for this purpose.

Small wooden sticks were dipped in dilutions of several insecticides, allowed to dry, and then exposed to Drosophila adults. Aldrin gave the quickest kill during the first 20 hours of exposure, but dieldrin continued effective in killing the adults after 15 days. These tests

suggest that dieldrin may be useful for treating picking baskets, bodies of collecting trucks and receiving platforms often frequented by large numbers of Drosophila adults providing it can be shown that such treatment will result in no residue hazard problems.

In tests in Colorado Drosophila breeding in 10-bushel piles of cull peaches was reduced about 99 percent by applications of lindane in the granular form. Dieldrin, aldrin, malathion and DDT in the granular form were slightly less effective, ranging from 92 to 97 percent. Lindane was less effective as a dust than in the granular form.

Studies were made of the insect contamination problems in 17 fruit and vegetable processing plants of the Pacific Northwest. Thrips on cane berries, mites on prunes, Drosophila adults on strawberries, prunes, peaches and pears, orange tortrix on raspberries, and cherry fruit fly in cherries were found to be the most important contamination problems.

Plans - This work will be continued with the objective of reducing Drosophila contamination in fruits and vegetables to be processed by exploring methods for attracting and killing the adults in the field and around processing plants and for preventing the breeding of the insect in cull piles and other waste accumulations from processing plants.

Publications

Controlling Drosophila (Fruit Flies). Utah Agricultural College, Ext. Cir. 216. H. E. Dorst and G. F. Knowlton.

PHYSIOLOGY OF STORAGE AND RIPENING - MRD

Progress and Findings - 1954 Recommendation, "Expand research on post-harvest physiology of fruits and vegetables" (6/25)

Additional allotted funds permitted a substantial expansion of this work.

(a) Enzymatic Studies of Fruits After Harvest

One of the great advances in the field of biochemistry in recent years has been the demonstration that something that may well be the "respiratory mechanism" of the cell can be isolated and studied in vitro. This "respiratory mechanism" is a group of cellular particles, previously identified morphologically as mitochondria, which contain all the enzymes, in integrated form that can carry out the oxidation of organic acids of the citric acid cycle (the cycle associated with respiration).

This work is only in its beginnings and has been demonstrated for the most part with animal tissues. However, mitochondria have also been isolated from plant tissues and implications of such studies are far-reaching with respect to basic understanding of biological processes.

The immediate object of the work is the characterization of the cellular particles which contain the major portion of the respiratory mechanism of fruits and vegetables. This essentially involves taking apart the machinery of the cell and attempting to analyze the components. The ultimate goal is to obtain basic information on the aging of tissue which will allow the development of better techniques for the handling, storage and transportation of fruits and vegetables. In the first year's work, underway in cooperation with the University of California at Los Angeles, where special equipment and techniques are available, a mitochondrial enzyme system was isolated from plant tissue which had the ability to oxidize substrates of the citric acid cycle, but all substrates were not oxidized to the same degree and the oxidation ability could be stimulated and stabilized by a chelating agent. These findings give some insight to the make-up of the enzyme system involved in respiration.

Plans - For future work, the inhibiting components in the enzyme system will be studied, and the reasons for wide variability in oxidizing power of the system with age or previous storage or handling of the fruit or vegetable will be studied.

(b) Moisture Loss from Fruits

Work has been started on determining the rate of moisture loss from fruits under various storage conditions. One of the major troubles in obtaining such data is the difficulty of measuring relative humidity accurately at the comparatively low temperatures at which most fruits and vegetables are stored. In the work at Beltsville, Md. two different types of hygrometers are used. These are checked frequently against each other and also against a wet and dry bulb thermometer.

The tests have so far covered only a few commodities but some interesting results have been obtained. A wide variation was found in the rate of moisture loss between various products and in some cases between different varieties of the same commodity. We have tried to express moisture loss on a basis of the evaporating power of the air, which differs with temperature as well as relative humidity. The difference between the vapor pressure of saturated air

and the air in question is known as vapor pressure deficit and is often expressed in millimeters of mercury. Our results are expressed in terms of weight of water lost per given weight per hour per 1 mm. vapor pressure deficit. The rate of loss per unit of vapor pressure deficit is not constant except for the loss of small amounts of moisture. As the total loss increases the loss per unit of vapor pressure deficit decreases very markedly. This is probably caused by physiological or physical changes in the fruit which interfere with moisture travel through the cells at a rate sufficiently rapid to maintain a saturated atmosphere in the air immediately in contact with the surface of the fruit.

The data on the commodities which have been tested are as follows:

<u>Product</u>	Loss Mg./Kg/Hr./M M of Vapor Pressure Dif.
Apples, Jonathan	20-25
" Grimes Golden	40-60
" Golden Delicious	50-90
Peaches	300-1000
Tomatoes, Mature green	50-175
Squash, summer	800-1700

In the above data the range of values given represents data obtained either at 32° or 40°F. (or both) and at relative humidities of approximately 75, 85 and 95 percent. The low values were obtained at vapor pressure deficits which were usually about 0.25 mm and the high values at deficits of about 1.35 millimeter. The results at relative humidity of .85 (VP Deficit about 0.80) were intermediate between the two. It is obvious that peaches lose moisture 10 times as fast as apples and that some vegetables, such as summer squash even exceed peaches in moisture loss rate. Golden Delicious apples, the worst variety of all for shrivel, loses moisture 2-3 times as fast as Jonathan under similar conditions of moisture loss. It is not surprising that Golden Delicious need protective film packing in view of their propensity for moisture loss.

Plans - We need to work out moisture loss data for all of the important commodities at temperature and humidities commonly encountered. The effects of air velocity and packaging should be studied before the work is finished. Air velocity affects evaporating power of the air, therefore, air of a given humidity differs in its effect on the commodity, depending on its velocity. This means in practical terms that as air movement increases in storage rooms humidities should be increased as well. Just how much for a given increase in velocity is not known but it can be determined. These studies will be continued.

(c) Studies on the Cause of Browning of Fruit Tissue

When fruits are injured they usually turn brown. Some of the storage troubles of apples such as scald or breakdown are characterized by a browning of the flesh; freezing injury does the same thing and so does mechanical injury. The browning of the stems of cherries was shown to be caused by injury to the stems in handling. Examination of the constituents of normal and browned cherry stems by paper chromatographic methods revealed a marked disappearance of several phenolic compounds with browning. D-catechin, l-epicatechin, and isochlorogenic acid have been identified from this tissue and disappear with browning. Several additional substances disappear and work is in progress on their identification. Normal cherry leaves were examined as a possible source of cherry stem components but proved unsatisfactory. However, leaves of cherries infected with rusty-mottle virus were an excellent source of stem components.

In an investigation of the cause of apple scald, a storage disorder, the yellow pigments in the skins of 2 varieties of apples were studied, Grimes Golden, a scald susceptible variety and Golden Delicious, not a scalding variety. Six glycosides of quercetin were identified and tested as possible substrates for the browning reaction of scald. None would serve as substrates and it was concluded that the yellow pigments were probably not involved in scald. It was then found that by spraying the paper chromatograms of apple skin with the browning enzyme (polyphenoloxidase) that the browning substrates could be located. By this means the principal substrate for the browning of apple scald in Grimes Golden apples appears to be l-epicatechin. Golden Delicious apples also contain l-epicatechin but do not scald. Bartlett pears contain l-epicatechin and d-catechin in the skin which are probably responsible for the brown color with pear scald and pear bruising. The sugars of the skins of Grimes Golden apples and Bartlett pears were separated and identified by paper chromatography. Both apple and pear fruit skins contain sucrose, glucose, fructose, and xylose. Free xylose is not widely distributed in plants and its occurrence in fruit skins has not been previously known.

Plans - Work on scald and browning of plant tissue will be continued. The efficiency of utilization of energy from cell respiration to maintain the skin tissue in good condition will be studied. The effect of aeration and ethylene on scald are also being investigated.

Publications

Quercetin glycosides of Grimes Golden apple skin. H. W. Siegelman. Jour. Biol. Chem. (In press)

Detection and identification of polyphenoloxidase substrates in apple and pear skin. H. W. Siegelman. Arch. Biochem. Biophys. (In press)

Effect of scald on apple skin respiration. H. W. Siegelman and H. A. Schomer. Pl. Physiol. (In press).

The Sugars of Grimes Golden and Bartlett pear skins. H. W. Siegelman. Proc. Soc. Amer. Hort. Soc. (In press).

(d) Effect of Ethylene on the Respiration of Kelsey Plums at 68° and 90°F.

In previous season's work it was found that Kelsey plums do not ripen satisfactorily at 90°F. although the rate of carbon dioxide evolution was substantially higher at 90° than at 75° or 65°. It was also determined that ethylene treatment prior to ripening at 90° seemed to offset some of the detrimental effects of the high temperature. The effects of ripening temperatures and pre-treatment with ethylene on the oxygen uptake was studied in the current work. Kelsey plums were treated with 500 ppm of ethylene for 24 hours at 68° and 90° and then held for ripening at 68° and 90°.

Ethylene treatment for 24 hours greatly increased oxygen uptake for about 2 days as compared with the check while the increased rate of carbon dioxide evolution from the treated fruit was continued for a period of 6 days although the effect was relatively greater during the first 2 days. This was true at both temperatures, but the effect of ethylene was greater at the higher ripening temperature. The treated fruit was riper than the untreated at the end of the experiment when held at either 68° or 90°. Thus in some manner not yet understood, ethylene affects the inhibiting action of high temperatures on the ripening of this fruit.

Plans - These studies will be continued.

(e) Curing of Chinese Chestnuts Before Storage

Chinese chestnuts, a crop growing in production, are difficult to store because of decay development even at 32°F. In tests made at Beltsville on the 1953 crop, drying the chestnuts at a low temperature, 35°, to a moisture content of 35 percent before storage, and then packaging in polyethylene bags and storage at 25° permitted the nuts to be held in good condition for a year. The nuts developed a high sugar content under this treatment and remained bright in color and tender in texture. Similar samples which were dried to only 39 percent moisture and stored at 25° darkened in color and developed very unsatisfactory flavors in storage. From their appearance they are believed to have frozen although the freezing point of these nuts was found to be about 22°F. The development of sugar in the first lot described is regarded as especially desirable.

Plans - This work is being repeated on a larger scale with the 1954 crop.

- J. Proposal for Committee Consideration - Expand research on the physiological disorders that cause spoilage and loss of quality in fruits after harvest. Basic information on the process involved would make possible the development of methods of preventing deterioration due to these disorders. Specific problems to be studied are the physiological diseases that contribute most heavily to economic loss in the marketing of fruits. Scald of apples is one of these. In seasons favorable for scald development, the present method of control by the use of oiled wraps is not fully effective and thousands of dollars are lost from scalded fruit. The cause of scald and its control in all seasons is still not solved. Internal breakdown and soft scald of apples, and core breakdown and loss of ripening capacity in pears are other disorders that cause heavy losses. Chilling injury, a poorly understood functional disorder of some fruit, brought on by cold, non-freezing temperatures needs further study. Some varieties of apples are susceptible to chilling injury and so are cranberries, citrus fruits, pineapples, mangoes, olives, persimmons and many vegetable crops.

The metabolic processes in sound fruits and those affected by physiological disorders would be studied to yield clues for the substances formed when the disorders appear. It is known that chilling of some fruits can be detected by its effect on respiration and the evolution of ethylene. These studies would include the respiration of fruits, the substrates used in respiration and the role of volatiles produced by the fruit in the development of functional disorders.

PREVENTION OF INCOMPATIBILITY IN REFRIGERATED STORAGE IN THE MARKETING OF AGRICULTURAL COMMODITIES - Matching Funds - OES

Progress and Findings - Studies were conducted on apples in experimental storage rooms to determine what effect the stage or stages of maturity of the fruit has upon the retardation of storage scald and retention of firmness by activated carbon air filtration. Pressure tests and scald counts were taken on the fruit from each room. Fruit that was pre-climacteric when placed in storage and which received carbon air filtration averaged $1\frac{1}{4}$ lbs. firmer and had 8 percent less scald at the end of the storage period than identical fruit not receiving carbon air filtration. Pre-climacteric fruit stored in a room which received carbon air filtration and stored with an equal amount of post-climacteric fruit averaged $2\frac{1}{2}$ lbs. softer and had 14 percent more scald than fruit from an identical room that had no post-climacteric fruit present.

The use of activated carbon air filtration is not justified in the apple storage when one-half or more than one-half of the fruit is placed in storage in a post-climacteric stage of development.

Plans - Continuation of physiological studies with horticultural products in relation to the fundamental metabolic activities that have a bearing on deterioration in storage.

Publication

Air Filtration Studies in a Commercial Type Apple Storage. E. C. Maxie. 1953

REFRIGERATION IN TRANSIT ON QUALITY - MRD

Progress and Findings - 1954 Recommendations, "Expand work in the general field of refrigeration of fruits in transit by rail or truck with particular attention to salting practices with sweet cherries and strawberries, freezing injury and further studies on the use of modified refrigeration and ventilation under some circumstances to provide more desirable temperatures and more economical refrigeration." (8/25)

No expansion was made in this work in F.Y. 1955.

(a) Refrigeration of Bartlett Pears from Early Districts

Additional test shipments made in 1954 from California confirmed earlier results that modified half-stage icing provided adequate protection in transit and permitted some initiation of ripening which is desirable in the marketing of this early fruit.

At the request of the Advisory Board for the Promotion of Fresh California Bartlett pears an article was prepared to encourage the use of modified half-stage icing during the early part of the Bartlett pear shipping season. Several thousand copies of this were printed and distributed to the trade by the Advisory Board with the result that the suggested services were widely used and favorable results obtained.

Plans - These studies will be continued.

Publications

How to use transit time to eliminate ripening problems with California Bartlett pears. A. L. Ryall, printed by the Advisory Board for the Promotion of Fresh California Bartlett Pears. July 1954.

Transit protective services for Bartlett pears from the early California districts. A. L. Ryall. The Blue Anchor, Vol. 31, No. 3, August 1954.

(b) Salting Practices for California Strawberries

Serious freezing damage to many shipments of California strawberries to midwestern and eastern markets prompted a request for an investigation of salting practices on this costly commodity. Shipments have been made during the current season in which temperatures were obtained under the commercial salting practices in use and in cars supplied with about 1,000 pounds of dry ice in the body of the car as a mold inhibitor and suppressant of ripening. There was some question as to whether salt or dry ice is responsible for freezing. Air temperatures obtained in test cars showed that the standard salting procedure (2%) and approximately 1000 pounds of solid carbon dioxide in the brace sometimes produced air temperatures below 30°F. for short periods but average transit temperatures were usually above 35°. No freezing injury occurred in any of the test shipments.

Plans - These tests will be continued.

Publications - None

(c) Effect of Loading Method on Air Circulation and Protection of Apples from Freezing in Transit

Standing tests were made of bunker- and floor-fan equipped cars of apples loaded 7 and 8 boxes wide with divided loads (bracing at the center) or through loads. While the fans were being operated by electric pre-cooling motors, measurements of air velocity through the stacks of boxes were taken at 30 locations on top of the load. Thermocouples placed at some of these locations top and bottom of the load were used to record temperature changes while heat from 2 Preco car heaters was added in each bunker. Air moved through the stacks with greater velocity when loaded 8-wide, and in 3 out of 4 comparisons in through loads. The higher velocities observed with the tighter 8-wide loads were accompanied by a small decrease in total volume circulated. A greater volume of air was moved through the stacks by floor fans with a corresponding greater velocity than by bunker fans when similar loads were compared. Temperature differences between top to bottom of the load were greater, particularly at the sides of the car, when loaded 8-wide. Wall-flues reduced temperature differences only about half as much as did the 7-wide load.

Plans - Transit test comparisons of 7- and 8-wide loads under winter conditions were not possible due to uncertain apple movement. Such transit tests are planned in 1954.

(d) Refrigeration of Massachusetts Cranberries in Transit

Studies were continued on the transit refrigeration of prepackaged cranberries in fiberboard master containers. Test shipments were made from Massachusetts to Los Angeles and Chicago in which hydrocooling was tried experimentally and car-precooling with car fans was given commercial trials. The use of salt on the bunker ice was also tried as a method of speeding up cooling of the cartons of cranberries. By precooling the cars 18 hours, a temperature reduction of 21° F. was obtained, whereas the check carload cooled only 8° in a similar time. The results of these tests are not complete.

Plans - This work will be continued.

Publications

The effects of precooling, load pattern and carton ventilation on temperature, moisture condensation and spoilage of prepackaged early black Massachusetts grown cranberries by H. W. Hruschka, W. H. Redit, G. B. Ramsey, M. A. Smith, E. M. Harvey and E. P. Atrops. Submitted for publication.

- K. Proposal for Committee Consideration - Expand research on the refrigeration of fruits in transit to develop refrigeration services that are nearer the requirements of the fruit. Tests would be conducted to determine the refrigeration requirements as affected by loading temperatures, outside temperatures, transportation equipment distance to market, and desired degree of ripeness of fruit at destination. The data obtained would be used to develop refrigeration practices that would in many cases cost less and deliver the commodity at the market in better condition. Tests also would be conducted to improve the performance of refrigerator cars and determine the capabilities of the mechanically refrigerated cars. Tests would be made of the control of air circulation in the cars by thermostatically controlled fans and other means. Mechanically refrigerated cars would be tested for fruits in conjunction with various precooling methods.

CONTROL OF DECAY BY COOLING AND CHEMICALS - MRD

Progress and Findings - 1954 Recommendations "Expand work on methods of cooling fruits by means of hydrocooling, vacuum cooling and tunnel cooling with special emphasis on the volume of air, air velocities, and the usefulness of decay preventatives in the water of hydrocoolers." (9/25)

A substantial expansion was made in the work on decay preventatives in the water of hydrocoolers during F.Y. 1955.

(a) Peach decay control by hydrocooling and chemicals

The effectiveness of chlorine and other fungicidal materials in hydrocooling water for control of peach decay was investigated in tests at Beltsville. The tests were made with peaches that had been inoculated with spores of either the brown rot or rhizopus rot fungus. After hydrocooling, half of the peaches were kept at 75° F. for 6 days and the other half were kept at 40° for 5 days and then at 75° for 6 days to simulate a period under transit refrigeration followed by a 6 day marketing period. When the peaches that had been held at 75° F. were examined there was 79 percent decay in the fruit that had not been hydrocooled, 79 percent in fruit hydrocooled in plain water and 45 percent in fruit hydrocooled in sodium hypochlorite treated water containing 200 ppms. of chlorine. The peaches kept at 40° and then at 75° had 81, 87, and 54 percent brown rot, respectively, for the same treatments. These results indicated that hydrocooling without chlorine had little or no effect on brown rot and that the addition of chlorine reduced brown rot less than half. Hydrocooling with or without chlorine had little if any effect on rhizopus rot there being 91 percent in the fruit that was not hydrocooled, 93 percent in fruit hydrocooled in plain water and 82 percent in fruit hydrocooled in the water containing chlorine after 6 days at 75° and 59, 38, and 42 percent, respectively, after 5 days at 40° followed by 6 days at 75°. Lowering the pH from 9.3 to 7.0 and 5.0 did not change the effectiveness of the sodium hypochlorite solution.

Preliminary tests were made with other chemicals that might be used in hydrocooling water for decay control. In these tests inoculated peaches were immersed in ice water containing the various chemicals for 15 minutes and then kept at 75° for 6 days. When the peaches were examined the respective amounts of brown rot and rhizopus rot in the fruit from the various treatments were: Tween 20 (a wetting agent), 98 and 96 percent; sorbic, 100 and 92 percent; Dowicide-A, 43 and 48 percent; lime-sulfur, 52 and 93 percent; and Captan 58 and 77 percent. Of these materials only Dowicide-A appeared to be better than chlorine.

Plans - These tests will be continued.

(b) Precooling and Shipping Peaches from Georgia and S. Carolina

Studies of the precooling of peaches in the Southeast were continued in a year that found practically the entire crop hydrocooled with the greater part shipped by refrigerated truck. Tests, conducted on the two types of commercial hydrocoolers in use and on several home-made units, indicated satisfactory results if properly operated, reducing temperatures from around 85° to 50° in 10 to 12 minutes. If the unit

was speeded up or not iced properly, temperatures of 55° to 60° were obtained. By slowing down the speed, temperatures of 40° or lower were obtained in around 23 minutes. All coolers tested used ice except one which was mechanically refrigerated. Custom cooling in large tanks in which lidded baskets were immersed in circulating iced water was observed. Temperatures were reduced by as much as 30° in 20 minutes without noticeable effect on the pads or liners.

Transit temperatures recorded in 4 hydrocooled and 1 warm load of peaches shipped by truck-trailer showed that peach temperatures obtained by hydrocooling (50°) were maintained in transit in equipment typical of that normally available. The one non-precooled load was shipped in a trailer with a 3,000 lb. ice bunker capacity instead of the usual 2,000 lb. and temperatures were reduced from 74° to 52° en route by frequent re-icings and a total meltage of about 10,500 lbs. of ice.

Temperatures of hydrocooled peaches were maintained when held overnight in partially loaded, pre-iced refrigerator cars. When peaches were stacked on the packing house floor after cooling, temperatures rose as much as 10° in outside fruit in baskets in the outer layer of the pile. The use of a wetting agent in the cooling water to increase the cooling rate was studied, but excessive foaming occurred before an effective concentration was reached.

The temperatures of hydrocooled peaches loaded in a mechanically refrigerated car were reduced from 52° to 40° in 18 hours, being maintained at that point in transit. To speed ripening at destination, temperatures of the peaches were raised to around 50° during a 9 hour period just prior to unloading by re-setting the thermostat and applying heat to the load from the mechanical unit.

Plans - These studies will be continued.

Proposal for Committee Consideration - See page 154.

CONTAINER AND PACKAGE EVALUATION IN RELATION TO PRODUCT QUALITY - MRD

Progress and Findings - 1954 Recommendation, "Expand research on pre-packaging to include development and evaluation of consumer packages and master containers for plums, prunes, peaches and grapes." (12/25) A slight expansion was possible.

"Expand work on development of improved and cheaper shipping containers for deciduous fruits." (14/25) A slight expansion was possible.

(a) Various Types of Film Bags for Sweet Cherries

One-pound lots of cherries packaged in perforated and non-perforated bags of polyethylene, K202, LSAT cellophane, W26, and Mylar films were compared with similar fruit packed in 15 lb. wooden lugs. All lots were stored for 5 and 10-day periods at 31° F. and 40°, examined, then held an additional 2 days at 70°. The cherries in film bags generally retained a fresher appearance than the check fruit in boxes. Polyethylene did not make an attractive package for cherries because of condensation and the characteristic translucence of the film. Non-perforated polyethylene caused loss of varietal flavor in 5 days storage with off-flavors and flesh injury appearing in the added 2 days at 70°. Non perforated K202 film impaired varietal flavor in 5 days' cold storage at either temperature and caused flesh injury and off-flavors when held an additional 2 days at 70°. Fruit in non-perforated LSAT cellophane bags had anaerobic odors after 5 days cold storage at 31° or 40° and 2 days at 70°; off-flavors were noted following 10 days at either temperature and 2 days at 70°. The film became wet in storage and lost the attractive appearance it had at the time of filling. None of the films when perforated caused undesirable odors or flavors of the fruit. Non-perforated W26 bags caused loss of flavor in 5 days storage at either temperature, and tissue injury and off-flavors during the additional 70° storage. The attractiveness of this film, however, was only fair due to translucence and a tendency to cockle. Mylar film either perforated or non-perforated, did not cause any observable adverse fruit conditions. Visibility of the film was generally better than the others, and no tendency to cockle in storage was observed.

Plans - Studies will be continued on the suitability of various films for prepackaging cherries.

(b) Polyethylene Box Liners for Apples, Pears and Grapes

Western Grown Golden Delicious and Jonathan Apples: The weight loss, composition, appearance, and dessert quality of Golden Delicious apples were compared when packed in polyethylene liners in standard wooden boxes and in standard cell cartons in studies made at Wenatchee, Wash. Film closure was made by fold-over and by twist-seal of the film.

The type of film closure had no significant influence on the loss in weight of the fruit; weight losses after 190 days of cold storage were less in fruit in the standard wooden boxes (0.85%) than in the cell cartons (1.95%). No accumulation of CO₂ or reduction of O₂ was obtained in the fold-over film of the bulge pack in the standard wooden box. The fold-over and twist-seal of the film in the cell carton both permitted CO₂ and O₂ concentrations of 2 to 3 and 17 to 18 percent respectively. This was undoubtedly due to the better seal obtained in the flat pack of the cell carton. There were no significant differences in the composition or dessert quality of Golden Delicious apples as related to type of film closure.

The chief benefit derived from the use of polyethylene liners in the packaging of Golden Delicious apples is in the prevention of moisture loss and the preservation of fresh appearance. The fold-over film seal is now used commercially for cell carton packs of fruit and packing operations have been facilitated thereby.

Plans - This work will be continued. The use of sealed polyethylene film liners for the control of soft scald in Jonathan apples is under limited study.

Eastern Grown Golden Delicious Apples: The previously reported conclusions as to the benefits of using moistureproof film box liners for Golden Delicious apples grown in the northwest were substantiated at Beltsville, Md., with eastern-grown Golden Delicious. Apples in polyethylene-lined boxes were still in good condition with no shriveling and only 1 percent weight loss after 6 months' storage at 31°F. Check boxes with regular paperboard liners were unsalable then because 70 percent of the apples were shriveled and weight loss was about 7 percent. Non-sealed polyethylene bag type box liners were as satisfactory as sealed liners for preventing shriveling and weight loss. Although there was some beneficial gas-storage effect on the apples in sealed film-lined boxes after 6 months at 31°, there was some injury evidenced as an off-flavor. Oxygen was depleted to less than 1 percent in one box with a sealed film liner at 31°. Injury in the form of off-flavors became especially pronounced when sealed film liners were not perforated on removal from cold storage and the apples were held 6 days at 70°. Film box liners made from 2 overlapping polyethylene sheets were also satisfactory for maintaining good quality by reducing weight loss and eliminating shriveling.

Plans - These studies will be continued with Rome Beauty, Grimes Golden, McIntosh and Golden Delicious apples.

New York Grown McIntosh Apples: Although sealed polyethylene liners were of slight benefit in retarding ripening of McIntosh apples in studies at the New York laboratory, other defects developed as a consequence of this treatment thus making the over-all value of apples thus stored in polyethylene liners little if any better than those stored without liners in cold storage and substantially below apples stored in commercial modified atmosphere storage.

Plans - No further work on this problem is contemplated at the New York laboratory.

California Yellow Newtown Apples: Yellow Newtown apples grown in the Pajaro Valley of California develop internal browning if stored at 32°F. and because of this they are stored at 36° to 38° and 40° would be even better for the control of this disease. At 36° to 40° storage life is shortened and apple scald, another physiological disease, may become a serious problem. Experimental work was begun at Fresno, Calif. to see if film liners would provide desirable concentration of carbon dioxide and oxygen that might be helpful in lengthening storage life at 40°.

Yellow Newtown apples grown in the Pajaro Valley of California, packed at harvest with and without oiled wraps in sealed polyethylene liners of two weights and without liners were stored at 31° and 40° F. for 185 days. Oxygen and CO₂ determinations of the sealed package atmospheres showed equilibrium at about 6 percent O₂ and 4.5 percent CO₂ in polyethylene 150 (1.5 thousands of an inch thickness) at 40° from the fifth week until the end of the test. In the same liner at 31°, O₂ decreased and CO₂ increased continuously to final levels of about 2.5 and 6.5 percent. Internal browning affected every apple stored at 31° whereas all stored at 40° were relatively free from the disease. Apples stored in polyethylene 150 at 40° remained firmer and better flavored than other lots at either temperature and developed far less common scald than check lots at either temperature. Oiled wraps reduced scald at 31° but were not effective at 40°.

Plans - Studies will be continued, trying laminated films and a temperature of 45° F. as well as 40°.

Anjou and Bartlett Pears: The keeping quality, gas concentrations, and rate of cooling of pears in polyethylene laminated fiberboard cartons and standard wooden pear boxes and without polyethylene liners was compared under commercial storage conditions at Wenatchee, Wash.

In only the regular sealed polyethylene bag used as a liner for boxes was it possible to modify the composition of the storage atmosphere to 3 and 17 percent CO₂ and O₂, respectively, during storage from October to April. Pears in the standard wooden box lost 4.20 percent in weight by April 6; 0.43 percent in sealed polyethylene liners, and 1.60 percent in fiberboard cartons laminated with polyethylene. The laminated carton did not prolong the potential storage life of the fruit. Shelf life of the ripened pears previously stored until April in sealed liners was about 9 days longer than in any of the other lots; texture and flavor of the former were also far superior to the latter.

Plans - Work is in progress with Bartlett and Anjou pears in which new types of polyethylene films are being evaluated. Some experiments on sealed polyethylene liners for pears under simulated transit conditions are underway. A survey of commercial experience and results of packing pears in sealed film is being made. Considerable time and effort in an advisory capacity is being given the pear industry due to its extensive and rapid commercial adoption of polyethylene liners for pears.

Publications

Effects of sealed polyethylene box liners on the storage life of Watsonville Yellow Newtown apples. Submitted to Am. Soc. Hort. Sci. September 24, 1954 for publication in the proceedings. A. L. Ryall and M. Uota.

Polyethylene film box liners reduce weight loss and prevent shriveling of eastern-grown Golden Delicious apples, 1953-54 season. R. E. Hardenburg. H.T. & S. Office Report No. 315, 14 pp., August 1954.

Film liners for boxes of pears and apples. Fisk Gerhardt and Harold Schomer. Pre-Pack-Age 17: 14-17, 1954.

Sealed film box liners for pears and apples. Fisk Gerhardt. U. S. Dept. Agr. Cir. (In Press).

Dates of examination of volatiles from pears and apples. Fisk Gerhardt. Amer. Soc. Hort. Sci. (In Press).

The storage of pears and apples in the presence of ripened fruit. Fisk Gerhardt and H. W. Siegelman. Agr. and Food Chem. (In Press).

Emperor Grapes: The investigation to determine whether the storage life of grapes could be extended by using sealed film liners was continued. During the 1953 season polyethylene of 100, 150, and 200 gauge (1.0, 1.5 and 2.0 mils thickness) was used to determine whether the thickness of the film was a factor in the suitability of the liner. The Emperor grapes used in this experiment were initially fumigated with 1% sulfur dioxide before being placed in the liner. In each liner either a small amount of crystalline sodium bisulfite was included or the fruit was sprayed with a solution of bisulfite before the liner was sealed. The fruit was held in storage for 110 days before inspection. At the end of this period the average concentrations of carbon dioxide in the 100, 150, and 200 gauge liners were 3.7, 5.1, and 6.8 percent respectively. Oxygen concentrations in the same liners were 11.7, 8.1, and 6.7 percent. The fruit in the liners

containing crystalline sodium bisulfite developed very little decay and remained firm and bright throughout storage but showed excessive berry bleaching from the confined SO_2 . There was no visible shrivel in stone or fruit whereas the check fruit showed considerable shriveling around the capstem and drying of stems and capstems. The appearance of the sealed liner fruit sprayed with bisulfite solution was very poor because the stems and fruit darkened during storage. The gauge of the film seemed to have little effect on the results obtained. Both 200 and 150 gauge liners were effective in bringing about modified atmosphere in ranges which appeared desirable.

Plans - Studies with grapes will be continued in which liners with various amounts of ventilation will be tried and several methods of adding sulfur dioxide will be tested.

(c) New Shipping Containers on Deciduous Tree Fruits

Fresh Plums: In cooperation with the California Grape and Tree Fruit League and the University of California a shipping test was conducted in which 3 loading patterns for carton-packed Duarte plums were compared for product protection and cooling rate of the fruit during transit.

During 14 hours in the precooling room the fruit in all of the test cartons cooled about 20°F. to a final temperature of about 62° at loading. Cooling was slow in transit even though the car was equipped with fans. None of the load patterns used was outstanding from the standpoint of cooling. Cartons in the middle layer of the load cooled slowly from 62° to about 42° during the 9-day transit period to New York. All cartons used protected the fruit satisfactorily but due to slow cooling more ripening occurred during transit than was desirable.

Plans - This work will be continued.

California Bartlett Pears: In cooperation with the Advisory Board for the Promotion of Fresh California Bartlett Pears, the California Grape and Tree Fruit League, and the University of California 2 shipping tests were conducted during the Bartlett pear season to compare several types of experimental packages with the standard wooden box. The experimental containers tested included 3 of corrugated fiberboard, 1 of veneer, and 1 with wooden ends and fiberboard sides.

The first test involved car precooling and indicated that none of the cartons cooled as well as the standard box, principally because no method was available for spacing the cartons in the car so that air could circulate about them freely. All of the packages tested withstood shipment well and the fruit was protected as well in the experimental containers as in the standard boxes.

Fruit for the second shipping test was room-precooled for several days after packing and differences in rate of cooling were not striking although the wire-bound veneer crates and the standard boxes cooled somewhat more rapidly than the cartons. All of the packages withstood handling and shipment well and gave satisfactory protection to the fruit. Wrapped fruit showed somewhat less injury than placed-pack fruit without wraps.

Plans - This work will be continued.

Northwest Pears and Apples: Work is now in progress at Wenatchee, Washington, in cooperation with the Oregon-Washington-California Pear Bureau, Experiment Stations of Oregon and Washington, and Transportation and Facilities Branch in testing a new fiberboard box for storing and shipping pears. A single box was selected from those submitted as having the most promise, and it is being compared with one chosen last year and the standard wooden pear box. Pilot plant operations in which the new box is being tested have been set up in each of the 4 principal winter pear districts.

The box selected this year is a telescope box, and has a total of 5 thicknesses of corrugated fiberboard on each end and 3 on each side when assembled.

The cooling rate, CRA (cooling rate per degree temperature difference per hour between commodity and air) of fruit in commercially packed and stacked, fiberboard cartons, and standard wooden pear boxes with and without polyethylene liners in the center rows of stacks in the room, where cooling was slowest, were quite similar. The similarity of cooling rates for the various packages suggests that the paper fruit wraps and the air spaces between wraps constitute the major resistance to heat removal from a standard wrapped pack of pears. Studies are being made on the rates of cooling of the new box in each of 4 different methods of stacking and in cold storages with different types of air movement. Ability of the box to stand up in storage and transit and air tightness of the boxes are being observed. The effect of the box on bruising, length of permissible storage period, rate of ripening upon removal from storage, and quality of the fruit will be observed.

Similar studies, less extensive in nature, are being conducted on the use of fiberboard boxes for apples in the Wenatchee area. These studies are in cooperation with the Washington State Experiment Station and a committee of growers and shippers.

Fiberboard boxes recommended for use in packing 10 - 4 lb. consumer bags, a 350-pound double wall fiberboard tray box and a 200-pound single wall fiberboard box with new kraft-veneer liners are all being observed for their stacking strength and other qualities necessary for satisfactory storage and shipping containers.

Plans - These studies will be continued.

EXTENDING THE SHELF-LIFE OF SHELLED NUTS BY PACKAGING - MRD

Progress and Findings - 1954 Recommendation, "Initiate work on development of improved methods of prepackaging shelled nuts." (13/25) No new work was started but the going work was expanded slightly.

The work initiated in 1949 on methods of improving the shelf-life of shelled nuts was continued. Laminated, transparent plastic film bags were again used for these tests. This year we were able to seal some of the saran combinations so that they held satisfactorily. Bags made of a saran-cellophane lamination were compared with laminations of cellophane and pliofilm and with an antioxidant coated cellophane. Bags, formed from the film, were filled with shelled nuts and flushed with carbon dioxide or nitrogen to eliminate air. They were heat sealed immediately, and stored at 70° F. Control samples were sealed in air, some of which were stored at 70° F., 32° F. and 0° F.

The samples were examined after 2 and 4 months' storage. At the end of 2 months, although there was some difference in the order of rating between pecans and walnuts, those samples in the Saran-cellophane bag under either CO₂ or N₂ were as good as those which had been kept refrigerated. The nuts which were packed under gas in the cellophane-pliofilm bags were usually rated lower. The antioxidant treated film did not prove satisfactory for preventing rancidity. Nuts which had been treated to destroy enzymes rated poorly after 2 months at 70°F.

After 4 months nuts held at 0° F. were best with those under CO₂ in Saran-cellophane almost as good quality. Those under nitrogen were judged to be slightly inferior in flavor to those in CO₂. Carbon dioxide however has the disadvantage that it is strongly absorbed by the nuts, creating a partial vacuum within the package and drawing the film tightly over the enclosed nuts. This appearance is not regarded as satisfactory from a sales standpoint. There have been instances where CO₂ was believed to give "off" flavors although it was not found in our tests.

Oxygen content of the atmosphere within packages was measured after 10 months' storage. Results are as follows:

	% O ₂
Saran-Cellophane (under N ₂)	7.0
" " (" CO ₂)	16.0
Cellophane-Pliofilm (CO ₂ or N ₂)	19.6

A commercial trial of about 300,000 pounds of shelled walnuts packed in Saran-cellophane bags in nitrogen is underway by the California Walnut Growers Assoc.

See also page 76.

Plans - Studies will be continued with walnuts and pecans, trying several new film combinations and some anti-oxidants not previously tried.

Publications

Sorption of carbon dioxide by nut meats. A. W. Wells - Science. 120:3109 p 188 July 30, 1954.

STUDY OF THE QUALITY OF STORED PECANS - Matching Funds - OES

Progress and Findings - A total of 37 treatments were tested in an attempt to improve present methods of conditioning pecans by increasing moisture to reduce breaking of kernels during shelling. Most satisfactory treatments included (a) five pounds steam pressure for 6 to 8 minutes and cracked after 5 minutes; (b) steam at atmospheric pressure for 10 minutes and cracked after 5 minutes; (c) water at 190° F. for 20 minutes and shelled after 15 minutes; (d) water at 70° F. with a 0.01 percent wetting agent (sodium tetraphosphate) for 20 minutes and cracked after 24 hours; (e) humid atmosphere (90 percent) at 70° F. for 48 hours and (f) water at 145° and cracked after 15 hours.

Heating pecans to an internal temperature of 190° F. prolonged shelf life at 70° F. by more than 2 months. Heating apparently inactivated the enzyme system thereby retarding the development of rancidity.

Varieties differed in keeping quality. On the basis of stability of freshness of unshelled nuts held in common storage, Alley, Mobile, Schley, Stuart and two numbered varieties, 1722 and 1727, rated highest among 26 varieties. The stability of Stuart and Schley was similar, refrigerated or unrefrigerated with or without vacuum or in different types of containers.

Refrigeration at 34° F. or lower at 70 percent relative humidity was more beneficial in extending shelf life of pecan meats than was vacuumizing at 22 inches in glass jars or packing in CO₂ gas in glass or tin containers.

Plans - Will continue studies on prolonging shelf life by inactivation of enzymes with heat, stability of varieties in relation to oil and moisture content and evaluation and stability of pecan products.

Publications -

"Year 'Round on Pecans" by Refrigerated Storage. Woodroof, J. G., and Heaton, E. K. Ga. Exp. Sta. Jour. Series 228. Food Eng. 25(5):83-85, 141-142. 1953.

Keep Pecans in Refrigerated Storage. _____.
Ga. Exp. Sta. Press Bul. 646. May 1953.

Keep Pecans in Refrigerated Storage. Woodroof, J. G. and Heaton E. K. Peanut Jour. and Nut World. 32(8):23, 27. June 1953. Ga. Expt. Sta. Jour. Series 241.

Keeping Pecans in Refrigerated Storage. _____. Ga. Exp. Sta. Jour. Series 241. Ice and Refrig. 125(1):15-16. July 1953.

SUGAR-ACID RATIO AS INDEX OF MATURITY IN FREESTONE PEACHES

Progress and Findings - 1954 Recommendation, "Initiate work on the feasibility of using a rapid method for determining the sugar-acid ratio as an index of maturity in grading freestone peaches for processing." (25/25)

Work was not initiated on this problem because of insufficient funds.

POST-HARVEST DISEASES AND THEIR CONTROL - MRD

Fungicidal treatments for peach decay.

Progress and Findings - Post-harvest treatments with fungicides to reduce decay in peaches were continued at Beltsville. Materials that reduced brown rot as well or better than sulfur dust were: tetrachloroethylene (1:20,000) in combination with sulfur dust (94 percent); Dowicide M 140 (0.5 percent); captan (1.0 percent); Shell AL 126 (0.06 percent); Dowicide A, technical (0.5 Percent);

Dowicide A, pure (0.5 percent); and Shell OS 377 (0.06 percent), with reductions of 86, 69, 64, 57, 56, 54, and 49 percent respectively. Average reduction of brown rot in four years' tests with captan and Dowicide A, technical, were 71 and 62 percent respectively, while tetrachloroethylene in combination with sulfur dust, Dowicide A, pure, and Shell AL 126 reduced this decay an average of 71, 65 and 57 percent in 2 years' tests.

When applied for the control of rhizopus rot Monsanto CP 2229 (2.0 percent), Dowicide M 140 (0.5 percent); Dowicide A, technical (0.5 percent); tetrachloroethylene and trichloroethylene (as fumigants at 1 part liquid to 20,000 volumes of air) and Dowicide A, pure (0.5 percent) reduced rot by 78, 72, 63, 62, 61 and 57 percent respectively. Tetrachloroethylene, trichloroethylene and Dowicide A, technical, reduced rhizopus rot by an average of 59, 58, and 47 percent in 3 years' tests, while the combination of tetrachloroethylene and sulfur dust reduced this decay by an average of 51 percent in 2 years' tests.

Plans - These studies will be continued with more extensive trials on the promising chemicals.

The effect of refrigerating peaches on decay development

In tests at Beltsville, rhizopus decay was found to develop more slowly in peaches that had been stored previously at 40° F. than in those held continuously at 75°. Brown rot was retarded only while the fruit was at the low temperature. In these tests peaches inoculated with the rhizopus rot fungus and initially stored for 5 days at 40° developed only 42 percent decay when removed to 75° for 3 days compared with 95 percent decay in peaches not previously refrigerated. However, peaches inoculated with the brown rot fungus and initially stored at 40° developed 62 percent decay in 3 days at 75° compared to only 29 percent decay in peaches not previously refrigerated. Similar effects of temperature were obtained with peaches that had been treated with sulfur dust or Dowicide A and wrapped in copper treated fruit wrappers. The retarding effect of low temperature on growth of rhizopus on peaches, that persists after the peaches are removed from storage, is attributed to the peaches remaining firm and more difficult to invade by this decay organism. We doubt if the fungus itself is injured by cold temperatures, but this possibility is being explored.

Plans - These studies will be continued.

Effectiveness of antibiotics

Since antibiotics show considerable promise as fungicides and bactericides tests were continued at Beltsville with some of the newer ones, rimocidin, A-20, candicidin and streptothricin, for the reduction of brown rot and rhizopus decay of peaches. Candicidin (0.05 percent) equaled the reduction of brown rot obtained with sulfur dust and reduced rhizopus to slightly less than 50 percent of the check. A-20 (0.05 and 0.1 percent) reduced both brown rot and rhizopus rot by approximately 50 percent. Streptothricin (0.05 and 0.1 percent) reduced brown rot by approximately 50 percent. Rimocidin, effective against both decays in preceeding years, was almost completely ineffective in 1954.

Plans - Other antibiotics, not used for medicinal purposes, will be obtained or developed and tested against bacterial or fungal decay of post-harvest fruits. Also methods for determining residues of the antibiotics on fruits will be studied.

Fungicidal dip treatments for control of decay on sweet cherries

At Wenatchee, Wash., tests were made of control of decay in cherries by dipping the fruit in various concentrations of Monsanto CP 2229, "Wescodyne" (containing about 9.3 percent available iodine), captan, and sodium o-phenylphenate. The latter treatment was followed by a 10-second rinse in water. The treated fruit was stored in perforated polyethylene bags at 40° F. for 5 and 10 days and then held at 70° for 2 days before examining for decay. Monsanto CP-2229 at 2 1/2, 5, and 10 percent concentrations of the active ingredient very effectively reduced decay but tainted the fruit and caused stem injury. "Wescodyne" was ineffective at the 1, 2, and 3 oz. per 5 gals. concentrations recommended by the manufacturer. Sodium-o-phenate at 2, 4, and 6 percent of the active ingredient reduced decay but caused fruit injury and stem browning. Captan at 1/2, 1, and 2 lbs. per 100 gal. water was very effective in reducing decay, but a slight visible residue was present which imparted a salty flavor to the fruit. A rinse treatment probably would have removed this, but such a treatment was not included in the tests.

Plans - Further work will be conducted to find more satisfactory materials for preventing decay and means of preventing chemical injury.

Effectiveness of Sodium-ortho-phenylphenate and Calcium Hypochlorite in Control of Blue Mold Infections of Bruised Apples

Tests were made at Wenatchee to compare the effectiveness of chlorine and sodium-ortho-phenylphenate as fungicides used in apple washing. Golden Delicious apples used in these tests were bruised by slowly pouring from a height of 3' above an inclined chute, and inoculated by dipping momentarily in a spore suspension of blue mold (Penicillium expansum). Previous work had shown that freshly bruised areas are more easily invaded by blue mold organisms than unbruised tissue. Two hours after inoculation equal lots of fruits were dipped in a calcium hypochlorite solution containing 400 ppm. or 1000 ppm. available chlorine, or in a solution containing 0.6 percent sodium-o-phenylphenate (Stop Mold) and then drained, wrapped in oiled wraps, packed, and stored at 31° F. When the apples were examined 10 weeks later, the untreated fruit had 11.9 percent decay, the fruit treated with calcium hypochlorite had 20.9 percent and 18 percent decay respectively for the 400 ppm and 1000 ppm. concentrations and the fruit treated with "Stop Mold" followed by a water rinse had 7 percent decay.

Plans - Further tests will be made with sodium-o-phenylphenate to determine its effectiveness when used under commercial conditions.

The Effect of Sweating on Appearance and Decay of Sweet Cherries in Consumer Bags and in Boxes

The effect of sweating on appearance and decay in sweet cherries in wooden boxes with pads and liners and in sealed perforated and non-perforated polyethylene bags was studied at Wenatchee, Wash. Duplicate lots were allowed to sweat 1, 2, and 3 times during both a 5 and a 10-day storage period at 40° F. by exposing the boxes to 70° for 2 hrs. and then returning them to 40°. All lots were examined when taken from cold storage at the end of the storage period and again after 2 days at 70°.

Sweating had no effect on the amount of decay or on the condition of cherries in the box packs or consumer unit bags. After 5 days storage the amount of decay in perforated bags was greater than in non-perforated bags, the decay in the latter being comparable with that in boxes. However, after 2 days at 70° F. decay in bags and boxes was about the same. The same relationship existed after the 10 days storage as after 5 days, but after 2 additional days at 70°, decay in bagged lots was considerably greater than in boxed lots. Cherries in bags lost less moisture and the fruit and stems appeared fresher than those in boxes. The fruit in non-perforated bags after 10 days storage at 40° and 2 days at 70° had developed off-flavors associated with anaerobic respiration.

Plans - These studies will be continued.

Effect of Systox on Quality of Sprayed Pears and Apples

Systox, a systemic insecticidal spray containing 42 percent active ingredient, when used in the orchard at 1/4 pint and 1 pint per 100 gallons of water at 3 spray applications per season, did not alter the firmness, acidity, soluble pectins or carbohydrates in 2 varieties of pears and 4 varieties of apples in tests at Wenatchee.

The fruit was not adversely influenced by the Systox spray program in regard to maturity, storage behavior, freedom from physiological diseases, ripening characteristics, and shelf life.

A taste panel was not able to consistently detect any abnormal flavor, suggestive of Systox, in the dessert quality of the sprayed fruit. Other cooperating agencies have reported certain individuals able to detect an abnormal flavor in Systox sprayed fruit.

Plans - These studies have been completed.

Effect of Polyethylene Box Liners on Internal Breakdown and Decay of Bartlett Pears

In tests at Wenatchee, Wash., Bartlett pears packed in standard boxes and in boxes with sealed polyethylene liners were stored for 4 months at 31° F. and then examined for breakdown and decay after they had been removed from storage and held at 70° for 9 days. No breakdown was found in film-lined packs while from 33 to 67 percent breakdown was found in standard packs. An equal amount of decay (1 percent) was present in film-lined and standard packs in one grower lot; in the others there was 2 to 4 times more decay in standard packs than film lined packs. Variable results were obtained in some large commercial packs of Anjou pears which were held as late as May 1954.

Plans - Studies will be continued on decay development on fruit packed in film liners.

Effect of Nitrogen Fertilization on Bruising and Decay Susceptibility of Washington Apples

Winesap, Red Delicious, and Golden Delicious apples from trees whose leaf analyses reflected high and low nitrogen fertilizer applications were subjected to standard bruises and inoculated with a spore suspension of the blue mold (Penicillium expansum) fungus. Statistical analyses of the results have not been completed but from

preliminary examination it appears that while fruits from high nitrogen trees bruise somewhat more easily, the susceptibility to infection and growth of the fungus in apple tissue are not greatly influenced by nitrogen fertilization.

Plans - The tests are to be repeated during the 1954 season.

Relation of Condition of Chestnuts at Harvest to Decay in Storage

In a continuation of a study on decay of Chinese chestnuts at Meridian, Miss., in cooperation with the Fruit and Nut Crops and Diseases Section, ARS., it was found that decay was higher in nuts with broken stigmas than in those with intact stigmas. Very little decay developed in nuts having green stigmas at harvest. Nearly all nuts with split apices decayed. There was only 40 percent as much decay in stored nuts that were picked from the tree as in those gathered from the ground after they had fallen from the tree.

Plans - Studies have been initiated in cooperation with the Chicago Market Pathology Office to determine the casual organisms and methods of control.

Publications

"A progress report on studies of nut decay in Chinese chestnuts", by A. C. Gossard and L. J. Kushman has been approved for publication in the Annual Report of the Northern Nut Growers' Association.

Preharvest Treatments Reduce Grape Decay During Storage

Preharvest fungicidal sprays and dusts to reduce decay of grapes during storage were tested at Fresno, Calif. Previous tests had indicated that preharvest field infections by decay organisms are the primary cause of decay in stored California grapes. During the past season three of the fungicides applied in the vineyard significantly reduced decay in storage. However, the use of two of these materials is precluded because of phytotoxic or other adverse reactions. The remaining fungicide, captan (N-trichlorethyl thio tetrahydrophthalimide), appears to be the most acceptable of the materials tested for use in preventing field infections. Use of this fungicide, however, does not obviate the need for the customary sulfur-dioxide fumigation in storage. Without fumigation, post-harvest infections would not be controlled. Currently, captan is being tested under semi-commercial conditions in cooperation with several growers of Emperor grapes and Tokay grapes.

Plans - Further tests with other promising fungicides are contemplated.

Publications

Decay in stored grapes reduced by field applications of fungicides. John M. Harvey. (Approved by the Agricultural Marketing Service and submitted to Phytopathology). 1954.

Fumigation Studies on Storage Grapes

The fumigation of California table grapes with sulfur dioxide to control decay organisms is an established commercial practice. However, the treatment sometimes causes injury to the fruit. Injury may appear as sunken, bleached areas at the capstem attachment or as bleached pitted areas scattered over the surface of the berries. Studies have been conducted in an attempt to reduce this injury by varying the fumigation interval during storage and also by varying the concentration and length of exposure to the gas at the initial fumigation.

When separate lots of grapes were fumigated with 1/4 percent concentrations of SO_2 at 7, 14, and 21 day intervals, respectively, during storage, slightly less injury occurred at the less frequent intervals, but slightly more decay developed as the interval between gassings was extended. Differences in decay due to treatment became greater the longer the grapes were stored and also were greater in late harvested than in early harvested grapes. The data indicate that grapes should be fumigated at least every 14 days during storage.

The effect of varying the initial concentration and length of exposure to SO_2 was studied using Tokay grapes which are particularly susceptible to fumigation injury. Grapes were treated initially with 1/4 percent SO_2 for 40 min., 1/2 percent for 40 min., 1 percent for 40 min., 1/2 percent for 20 min., and 1 percent for 20 min. (check).

It was found that the pitting type of injury was greatly reduced by using the 1/4 percent SO_2 for 40 min. or the 1/2 percent for 20 min. rather than the customary 1 percent for 20 min. Injury at the capstem attachment, causing sunken, bleached areas, was not significantly different in the various treatments. However, the treatments which reduced SO_2 injury also resulted in poorer decay control as compared with the standard treatment of 1 percent for 20 min. Further study is necessary to determine the concentration and exposure that will adequately control decay with a minimum of injury.

There is evidence that the initial concentration and length of exposure to sulfur dioxide gas is more important in determining fumigation injury than the interval at which grapes are fumigated during storage. Injury at the capstem appears to be primarily a result of mechanical injuries which allow the gas to penetrate and bleach the berries. Initial gas concentration, length of exposure and interval of fumigation during storage have little effect on this type of injury and its reduction, therefore, is dependent upon more careful handling rather than upon modification of fumigation practices. Where pitting injury is a problem, as in the Tokay variety, there is promise that it can be reduced by modification of the initial fumigation practice. A manuscript covering this study is being prepared.

Plans - Further studies are contemplated on fumigation of grapes in storage.

Forecasting Decay in California Grapes During Storage

Studies have been conducted for the past three years at Fresno, Calif., to develop a method of forecasting the percentage of decay that will occur in grapes held in cold storage for several months. A laboratory test, in which incipient field infections by decay organisms are measured, has proven to be a reliable index on which to base such a forecast. The results of this test, which are available within 10 days after harvest, provide a means of determining which lots of grapes can be safely stored for long periods and which lots should be marketed early to prevent serious decay losses.

Information on the factors affecting infection by the various organisms causing decay in stored grapes was also obtained.

Plans - Studies are being continued to further improve the above laboratory method and to adapt it to actual commercial usage. Commercial adaptation of the technique is being studied in cooperation with a packer, shipper, and storage operator.

Publications

Forecasting decay in stored California table grapes. John M. Harvey. Phytopathology 44(9): 492. 1954.

A method of forecasting decay in California storage grapes. John M. Harvey. (Approved by the Agricultural Marketing Service and submitted to Phytopathology). 1954.

Grape storage losses cut. Marketing Activities. John M. Harvey. U. S. Dept. Agr., Agr. Marketing Serv. 17(5): 12. 1954.

Reducing Spoilage of Fresh Figs

The marketing of fresh figs is complicated by rapid spoilage of the fruit in the market. In simulated transit and marketing tests in the laboratory at Fresno, Calif., it was found that decay could be significantly reduced by dipping figs immediately after harvest in solutions of several fungicides. Results of treatment with sodium-o-phenylphenate (Dowicide A) / rinse, sodium bisulphite, and captan were the most promising. Figs treated with these materials had only about 30 percent as much decay after holding as untreated figs.

A test shipment of figs treated with the above fungicides was included in a carlot shipment to New York later in the season. Under the conditions of this test, no significant reduction of decay was obtained. Possibly field infections, which had occurred prior to the dip treatment were responsible.

Plans - Further studies are planned with these and other fungicidal dips to reduce fig decay. The role of field box sanitation as related to decay will be studied since fungus spores, bacteria, and yeasts abound in the fig residues in field boxes.

Strawberry Decay Control

Strawberries shipped from California to eastern markets in express refrigerator cars are relatively free from decay at unloading, but spoilage usually develops before the berries reach the retailer and consumer. Several post-harvest dip treatments were studied to determine their usefulness for retarding decay. Berries which were dipped in solutions of sodium bisulfite and sodium-o-phenylphenate (Dowicide A) / water rinse and shipped to Chicago had significantly less decay than untreated checks when unloaded. By the second day after unloading, the berries had about three times as much decay as after only one day. The treatments seemed to reduce botrytis decay more than rhizopus decay. On the first day of the holding period the predominant type of decay was caused by Botrytis but by the second day rhizopus decay was predominant. In the one day between examinations the amount of Botrytis decay doubled while the amount of Rhizopus multiplied almost eight times. This study was conducted in cooperation with the Strawberry Institute of Morgan Hill, California.

Preliminary tests were conducted at Beltsville, Md. with tetrachloroethylene, (1:20,000) Dowicide A (0.5 and 0.25 percent), captan (1.0 percent), sodium bisulfite (1.0 percent) and sorbic acid

(0.1 percent) as post-harvest dip treatments of 1 minute to reduce rhizopus rot of strawberries. All materials except sodium bisulfite reduced decay for 1 day at 70° F. by approximately 50 percent. All materials except captan caused severe burning of the fruit, and captan left an unsightly residue. Rinsing the fruit immediately after treatment lessened the injury and removed some of the residue. None of the materials gave effective decay reduction for more than 2 days at 70°.

Plans - Further testing of various fungicides is planned.

- L. Proposal for Committee Consideration - Expand research on fungicides to reduce post-harvest spoilage from diseases. Tests would be made to determine the effectiveness of chlorine and other chemicals now used in wash water and hydrocooling water under experimental and commercial conditions. Also new fungicides and combinations of fungicides would be tested to develop more effective treatments than those now in use and to develop control of diseases for which no satisfactory treatment has been developed yet. The fungicides will be tested for use as washes, dips, sprays and fumigants. Special attention will be given to fungicides, including antibiotics that can be used in wash water and hydrocooling water and to volatile fungicides for treating fruit in rooms or in cars after loading.

YIELD AND GRADE RELATIONSHIPS OF RAW AND PROCESSED RED SOUR CHERRIES - MRD

Progress and Findings - A grade relationship study on red sour cherries for processing initiated in 1953 was continued during the 1954 season in cooperation with the New York State Agricultural Experiment Station at Geneva, New York. The 1954 studies were conducted along the same lines as the previous year whereby lots of Station grown and commercially grown cherries were harvested at various stages of maturity, segregated on the bases of grade defects (chiefly scald) and processed at the Station pilot plant into frozen and canned cherries. Additional studies were conducted on the effects of (1) rough handling during picking, (2) holding times and temperatures after picking previous to cooling, and (3) various temperatures and times of water cooling to determine the effect upon the development of minor and major scald with subsequent effect on the grade of the canned and frozen product.

Results of the first two years' studies indicate that rough handling during picking, stage of maturity, holding times and temperatures and time of soaking, all affect the development of cherry scald.

Plans - It is planned to continue this study for one more year in cooperation with the New York Station. During the 1955 season a major part of the experimental work will be conducted in commercial plants to compare the results with those obtained in the pilot plant. Should the same results be obtained in commercial plants as were found in the pilot plant, it will demonstrate those practices which can be followed in processing plants to reduce the development of scald in cherries during processing.

WAX TREATMENT FOR PEACHES - MRD

Considerable interest has been aroused and questions raised regarding the waxing of peaches in the southeastern states. At the request of peach shippers, comparisons were made on the market behavior of commercially waxed and non-waxed peaches. Samples sent to Beltsville by express revealed no difference in arrival condition in the waxed and unwaxed fruit, and after holding for 3 to 5 days at room temperature there were still no differences in weight loss or decay. When the fruit was submitted to a panel of judges to detect any differences in appearance or condition, the judges could not pick out the waxed fruit from that not waxed.

Additional samples of fruit were held at low, medium and high humidities (72, 85 and 95 percent) at 32° and the peaches were weighed individually from time to time. Moisture loss was generally slightly less in the waxed fruit than in the unwaxed, but the differences were so small that the effect on the fruit could not be detected. Dixie Gem, Hale Haven and Sullivan Elbertas were used in these tests. The general conclusion from this test is that it would be hard to justify waxing of peaches from any benefits we observed.

Plans - No further work is planned unless the question of waxing becomes an urgent one again.

OBJECTIVE MEASUREMENT OF FRUIT MATURITY IN PEACHES - MRD

Progress and Findings - Studies were carried on in Georgia, S. Carolina, Virginia and Maryland in the 1954 season to develop objective standards of maturity for eastern-grown peaches. Previous studies placed emphasis on firmness of the fruit as determined by pressure test as an objective index and tentative standards in terms of pressure test readings were advanced. The work in 1954 was designed to test the

practical application of these standards in separating immature from mature peaches. In the 1954 season it was found that the tentative standards were only satisfactory in separating immature from mature fruit in about 65% of the lots studied. This agreement is not sufficiently good to advocate the adoption of standards based on firmness alone. A combination of pressure test and ground color seems to be the best method of arriving at a maturity standard for peaches. Further efforts toward developing more definite maturity standards will require a more accurate and usable color standard.

Objective maturity indices for five of the main commercial freestone peach varieties of California, Redhaven, July Elberta, Elberta, J. H. Hale and Rio Oso Gem were studied cooperatively with the California State Department of Agriculture. Pressure test readings, skin ground color, flesh color, titratable acidity, and acidity: soluble solids ratio made at harvest time correlated well with quality of the ripened fruit as rated by a taste panel. These data and the ripening rates of peaches of different stages of maturity from several orchards during quite different growing seasons, provide a basis for developing standards based on pressure test, color charts for skin ground color and flesh color, and titratable acidity. The soluble solids content of the juice, development of shape, softening of the suture, tip or shoulder of any variety, or the pit browning, or pit adherence of Redhaven or Rio Oso Gem peaches did not prove to be useful maturity indices. Peaches harvested prematurely were about 17 percent smaller than mature peaches, lost 10 percent of their harvest weight in shriveling during ripening, and were much less attractive.

Plans - Additional work is planned to evaluate a combination of firmness and ground color as a maturity standard for Eastern peaches. Future plans in California call for investigating additional indices and the adaptation of present ones to practical application by the industry. Standards for other varieties, especially some of the promising new introductions, should be worked on.

Publications

Maturity Indices for Peaches. Preliminary report of studies made in 1953. M. H. Haller and C. C. Craft. H.T. & S. Office Report No. 310. AMS-USDA

Freestone peach maturity studies in the Central San Joaquin 1953. Paul Rood. National Peach Council Annual 1954.

The development and evaluation of objective indices for California freestone peaches. Paul Rood and A. Lloyd Ryall. Presented before Amer. Soc. of Hort. Sci., Western Branch Meetings, Pullman, Washington. June 1954.

The development and evaluation of objective indices for California freestone peaches. Paul Rood. Presented before Amer. Soc. of Hort. Sci. national meetings, Gainesville, Florida, September 1954.

- M. Proposal for Committee Consideration - Initiate research on the development of an objective test for measuring the maturity of apples for processing using rapid methods for determining the sugar-acid ratio with the refractometer and the pH meter.

Apple processors have indicated the need for an authentic rapid and simple maturity test for apples. This would enable them to determine when the fruit are at the optimum stage of maturity, for processing into canned and frozen apple slices. Since the quality factors such as color and character in processed apple slices are affected by the maturity of the raw product which in turn determines the process to be used, it is vitally important that an accurate maturity index be devised by objective means.

A reliable objective maturity test for apples for processing will be of value to growers and processors since it will more accurately define the quality and thereby the price of apples bought and sold by them. It will also provide a means of quality definition which is objective rather than subjective. This work would also furnish the Fresh Standardization and Inspection Branch of the Fruit and Vegetable Division with a means of more accurately defining the grades of apples in the U. S. Standards for Apples for Processing.

PREVENTING DETERIORATION IN RETAIL STORES BY REFRIGERATION - MRD

Progress and Findings - Studies of the shelf life of fresh fruits and vegetables in retail store type display cases were continued under simulated retail store conditions at the Beltsville, Md. laboratory. It was found that all types of produce do not respond to any given treatment in the same way, and, accordingly, each individual fruit and vegetable must be studied under the various handling practices. Studies indicate that the keeping quality of most produce can be extended from two days to a week or longer when properly refrigerated and held at high humidity. (Sprinkling with water several times daily increased the humidity). However, some produce was injured when held continuously at temperatures below 50°F. for several days; and sprinkling with water increased the decay in certain fruits and vegetables.

The results of earlier studies of 14 different fruits and vegetables were previously reported. During the past year studies with green peppers, yellow summer squash, and Elberta peaches were completed and the results are in process of preparation for publication. With respect to Elberta peaches it was found that retail store refrigeration retarded the development of decay and ripening. Greatest loss in weight occurred in peaches displayed continuously without refrigeration. Moisture condensation due to changes in temperature from refrigerated night storage to room temperatures caused no apparent deterioration. Sprinkling with water several times daily had no harmful effect, but no material advantage resulted from this practice. The tests indicated that peaches that have not yet reached a desirable stage of ripeness should not be refrigerated, but those that are ripe may be held to advantage in refrigerated cases or stored at night in refrigerated rooms after daytime display in unrefrigerated cases.

Plans - Studies on Tokay and Thompson seedless grapes have not been completed. Additional studies are planned with pears, apples, peaches and strawberries.

RIPENING PEARS WITH ETHYLENE - MRD

Ethylene was used on some experimental shipments of Bartlett pears early in the season to see if it would accelerate ripening and help to get the fruit in condition for sale soon after arrival. The pears were treated in the refrigerator car after loading. A pair of cars was shipped to New York and another to Chicago, one car of each pair treated and the other not treated. All test cars received modified, half-stage icing.

Material response was obtained from the ethylene. Fruit in the treated car moving to New York was a little more advanced in ripening than desired at unloading whereas fruit in the check car was still too green and hard. The treated fruit shipped to Chicago arrived in an ideal stage for sale whereas the fruit in the untreated car required 6 to 7 days at 67°F. after unloading to reach the eating ripe stage. It appears that modified refrigeration services alone will provide sufficient initiation of ripening during transit to east coast markets but that treatment of the fruit with ethylene would be desirable for mid-western and west coast markets during the early part of the harvest season.

Development of the bright color in winter pears is desirable for ready consumer acceptance. The pear industry requested help in developing better color in fall and winter varieties of pears.

Preliminary work was done on Bartlett pears at Fresno, Calif. to determine the effect of ethylene as a pre-storage treatment for pears and whether it might be useful for later varieties. Trials made last year showed that ethylene treatment after the pears have been stored or refrigerated has little effect on ripening and yellowing. We do not know if pears treated before storage will develop more yellow color than non-treated pears. In tests made this season Bartlett pears, gassed 48 hours with ethylene at 500 ppm. concentration at a temperature of 70°F. before storage, were more yellow in color at the end of 4 and 6 weeks storage at 32° than fruit handled similarly but not treated with ethylene. The differences in color became somewhat greater upon removal from storage and in 2 days the treated fruit was 3.8 in the Calif. U.S.D.A. Color Chart, the untreated fruit 3.2, and fruit stored immediately at 32°, with no exposure to ethylene or 70°, 2.3. The color chart has yellow as 4.0, greenish yellow 3.0, yellow green 2.0 and green 1.0. The effect of the pre-storage ethylene treatment on softening of the pears was even more marked. Fruit treated 48 hours at 70° with ethylene had softened to 7.2 lbs. pressure test in 1 month at 32 and the comparable untreated lot had softened to only 13.7 lbs. The fruit stored immediately, without delay or treatment at 70°, was still 18.6 lbs. pressure test and had softened none in storage. Respiration determinations made on ethylene treated fruit gave further verification that the metabolism of the fruit in storage was accelerated by ethylene.

Plans - Studies are underway on the Bosc variety to see if ethylene treatment for 24, 48 and 72 hours before storage will bring about a more desirable yellow color of the fruit and shorten the time needed to ripen it out of storage.

GAS STORAGE FOR FRUITS - MRD

The possibility of keeping apples in better condition during long storage by supplementing low temperature storage at 31° with atmospheres higher in carbon dioxide and lower in oxygen were tried at Wenatchee, Wash.

Delicious and Golden Delicious apples were stored from October until July 27 in 3 large metal cabinets in which carbon dioxide and oxygen concentrations were controlled. The atmospheres of the three cabinets averaged 3.2, 4.4 and 6.2 percent oxygen, and 0.3, 2.4, and 0.4 percent carbon dioxide respectively for the storage season. Temperatures in the cabinets and in the storage room in which the check fruit was held were maintained at approximately 31° F.

Upon removal from the cabinets, the fruit appeared somewhat brighter and more attractive than the check fruit, which had lost more moisture than fruit from the humid sealed cabinets. Flavor of the controlled atmosphere fruit was decidedly acid, and lacked varietal characteristics. This acid flavor was substantiated by total acidity determinations. Total acid of the check Golden Delicious and Delicious at time of removal were .112 percent and .099 percent, and the average acidity of controlled atmosphere Golden Delicious and Delicious were .236 percent and .158 percent respectively. Texture of the controlled atmosphere fruit was judged organoleptically to be better than that of the check fruit, although there were little differences in firmness of flesh, sugars, or pectins between the check and controlled atmosphere fruits.

After a week at 70°, the check fruit was stale and had strong varietal flavor. Controlled atmosphere fruit did not develop staleness, but it never attained its true varietal flavor.

In general, the fruit held in controlled atmosphere was better in appearance and texture, but at the expense of varietal flavor. Fruit from the cabinet with 6.2 percent oxygen was more like the check fruit than fruit from the cabinets with 3 and 4 percent oxygen.

Plans - Controlled atmosphere studies are being continued this year using pears instead of apples. It is believed that controlled atmosphere storage would have greater application in the Northwest with pears than with apples. The application of controlled atmosphere storage by means of the polyethylene bag has met with singular success. In sealed bags, the controlled atmosphere consists of approximately 1 to 5 percent CO₂ and 15 - 17 percent oxygen. The metal cabinets are being used with pears this year, employing widely different atmospheric composition to determine the one which would be of greatest value in pear storage. Concentrations being tested are 16, 8, and 2 percent of CO₂ and 5, 3.5 and 3.5 percent respectively of oxygen.

Grapes

Controlled atmosphere storage for Thompson seedless grapes was investigated to determine whether any combination of altered partial pressures of carbon dioxide and oxygen would be effective in increasing the storage life of the fruit. The fruit was fumigated with 1% sulfur dioxide prior to storage and crystalline sodium bisulfite was included in each storage chamber. The modified atmospheres used were as follows: 2, 5 and 10% oxygen with 1, 5 and 10 percent carbon dioxide.

The results showed that controlled modified atmospheres slightly reduced the development of decay during storage and the sealed chambers greatly reduced weight loss. Grapes stored in 5% carbon dioxide and 10% oxygen seemed to have a slightly better flavor than the fruit stored in normal air. There was little difference in the flavor, appearance or storage life of the fruit held at different concentrations of oxygen and carbon dioxide. The fruit was held at 32°F. for 14 weeks before final inspection.

Plans - Controlled atmosphere storage of Emperor grapes will be studied the current season. In addition to the altered partial pressures of carbon dioxide and oxygen, periodic applications of sulfur dioxide will be made at low concentrations in an attempt to control decay and prevent darkening of the stems without causing bleaching injury.

AIR LEAKAGE AND GAS CONCENTRATIONS IN COMMERCIAL APPLE AND PEAR STORAGES - MRD

Data were obtained on the air leakage, carbon dioxide, ethylene, and non-ethylenic volatiles in 30 commercial fruit storages (20 percent of the space) in the State of Washington. The storages varied in size from 13,300 to 1,607,000 cu. ft.

Considering the range of air leakage rates encountered, a leakage rate of 2 air changes per day is considered fairly representative of a tight fruit storage. Ethylene was present in a range of 2 to 100 ppm. and non-ethylenic volatiles from 2 to 20 mg. per cu. ft. (expressed as mg. $\text{Ce}(\text{SO}_4)_2$ reduced). While individual CO_2 concentrations of 1 percent were encountered, values from 0.2 to 0.6 units must be considered typical. An analysis of air leakage costs in terms of wasted refrigeration indicated a seasonal expense of \$0.001 per bos for 1 daily air change. Considering the air leakage rates encountered, the costs for this region would vary from \$0.001 to 0.01 per box of fruit per season. Air purification by ventilation, if proved necessary, could be economically feasible in the cooler areas of the Pacific Northwest.

Plans - This project has been completed and the information has been published.

Publications

✓ Film liners for Boxes of Pears and Apples, by Fisk Gerhardt and Harold Schomer, Pre-Pack-Age 17: 14-17, 1954.

Air Leakage and Gas Concentrations in Commercial Fruit Storages, by G. F. Sainsbury and Fisk Gerhardt. Refrig. Eng. 62: 61-66, 111-114, 1954.

Sealed Film Box Liners for Pears and Apples, by Fisk Gerhardt, U. S. D. A. Cir. (In press)

Rates of Emanation of Volatiles from Pears and Apples, by Fisk Gerhardt. Amer. Soc. Hort. Sci. (In press)

The storage of Pears and Apples in the Presence of Ripened Fruit, by Fisk Gerhardt and H. W. Siegelman, Agr. and Food Chem. (In press)

FREEZING POINT DETERMINATIONS ON FRUITS AND VEGETABLES - MRD

In response to recommendations of the Cold Storage Advisory Committee work was reviewed on freezing points of fruits and vegetables. Accurate data are needed to guide cold storage operators, precoolers and transportation agencies in maintaining safe air temperatures. A recording potentiometer was used to follow the temperature drop and the sudden rise when freezing occurred. Freezing points were determined the past season for 6 varieties of apples, 7 varieties of sweet-potatoes, 8 varieties of potatoes, and also for 10 lettuce varieties each of which was grown in the field and in the greenhouse. Eighty-five freezing point determinations were made on 50 other species of fruits and vegetables as well as 35 additional ones on varieties of these.

Determinations of freezing points for a few of the more important fruits and vegetables will be checked for differences due to growing season and locality where grown. The need for such information was shown in 1953 by the fairly wide range in freezing points (27.4° minimum to 29.0° F. maximum) among the 6 varieties of apples studied. It seems even more important to know the possible range of maximum freezing points for each commodity and each variety. For the 6 varieties of apples studied the maximum freezing points ranged from 28.3° to 29.0° . Thus, the evidence seems to indicate that the

temperature at which freezing injury may occur varies considerably with variety. Previous storage treatment also affected freezing temperature. Among several commodities there was some evidence to show that merely storing the products for just one day at 32° lowered their freezing points as compared with specimens not subjected to such a low temperature. In these cases it is doubtful that changes from starch to sugar could have been sufficiently rapid to cause a lowering of the freezing points.

Plans - These studies will be continued.

TRANSPORTATION, FACILITIES AND PACKAGING

STUDIES OF APPLE AND OTHER FRUIT STORAGE PROBLEMS - MRD

Progress and Findings - 1954 Recommendations, "Expand work on methods of cooling fruits by means of hydrocooling, vacuum cooling and tunnel cooling with especial emphasis on the effect of volume of air, air velocities and type of package on the rate of cooling; the adaptability of the vacuum cooling method for different kinds of fruits; and the usefulness of decay preventatives in the water of hydrocoolers." (9/25)

It was not possible because of limitations of personnel to expand the engineering research phases of this work appreciably.

Cooling Rate Studies - In cooling rate studies at Wenatchee, Washington, during the past season emphasis has been given to the comparison of the cooling performance obtained with various types of containers and packing methods to that obtained with the standard wrapped pack fruit in a wood box. Pears wrapped and packed in wood boxes with polyethylene liners cooled as readily as did similar packs without liners. A similar situation was found when Golden Delicious apples were packed in a cell type cartons with and without liners. These observations indicate that a standard wrapped pack can be placed in a liner without appreciably penalizing the rapidity with which the package will cool. Tray packed apples in cartons with only the top layer wrapped and the standard pack in a wood box showed little difference in the cooling performance of these two packages. Perforation of the trays did provide some improvement of the cooling of the tray pack. Tests showed that wrapped cell pack cartons cooled slower by 25 to 20 percent than standard wood box wrapped pack.

Cooperating with the Oregon-Washington-California Pear Bureau some comparisons have been made checking cooling performance of experimental cartons under development against the cooling performance of the standard wood box. When a single thickness cardboard carton was used, the experimental carton cooled nearly as rapidly as the standard pack. Because this carton was structurally inadequate, a multiple thickness carton was developed and tested under several actual warehousing procedures. When stacked with sides exposed, the carton cools slower than the standard pack by 30 to 50 percent. However, when the cartons are stacked tight in double rows without side exposure and only one end exposed, the cooling is so much slower than similarly stacked wood boxes that such a stacking procedure is not recommended. These tests indicate that when multiple thickness cartons are used to provide maximum container strength, they should be stacked to provide good exposure to air circulation on both sides of the box.

High Velocity Cooling System - A pilot model of a high velocity cooling system for cooling packed soft fruits on a conveyor prior to lidding was constructed by a cooperating shipper and tested for use with cherries packed in 15-pound row-faced lugs; with apricots jumble packed in L. A. lugs; and with peaches packed in paper cups in L. A. lugs. On cherries, the operation was very successful, removing the majority of the field heat in 15 minutes and cooling to within 4 or 4 degrees of the cooling air temperature in 30 minutes. With apricots about 1/2 the field heat was removed in 20 minutes and in 30 minutes fruit temperature was within 10 degrees of the cooling air temperature. Although the system was not used on the apricot pack, sufficiently fast cooling is obtained to justify its use. To cool peaches adequately, more conveyor will be needed than was constructed. Tests indicated that a worthwhile reduction in the time required to cool peaches in the pack currently used will not be attained unless an exposure to high velocity air is provided for a period of from 30 to 40 minutes.

Hydrocooling - Tests made in cooperation with the Biological Sciences Branch on hydrocooling of cherries have served to determine a cooling coefficient for this type operation. Cooling is about four times as fast as that observed in the high velocity cooling system.

Modified Atmosphere Storage - Working with the Biological Sciences Branch three modified atmosphere test cabinets were constructed to test the response of Red Delicious and Golden Delicious apples to storage in atmospheres of 3 percent oxygen and 2.5 percent CO₂; 3 percent oxygen and no CO₂; and 5 to 6 percent oxygen and no CO₂

when fruit was held at 30 to 31°F. Fruit condition deteriorates less under first two conditions than under the last condition or under ordinary atmospheric storage at 31° F. Firmness of first two lots of Red Delicious at time of removal from storage was about the same as observed in check lot two months previously. Differences in firmness of Golden were not significant, but other indexes indicated some condition benefits from first two treatments.

Fruit flavor was altered by modified atmosphere treatments, the fruit having a sharply acid taste when removed from storage. At no time after removal did the Red Delicious regain their distinct varietal flavor; however, neither did they become stale after prolonged exposure at room temperature. Check samples did become stale in this period and such behavior is normal to the variety. Golden Delicious flavor was not so adversely affected by the treatment but showed some similar trends.

From this year's work it appears that there is some condition benefit available from this treatment, but flavor is adversely affected. The failure of the 5 percent oxygen treatment to produce condition benefit indicates the importance of having a truly gastight storage room capable of attaining the low 3 percent level.

Insulation Investigation - A follow-up test was made on an aluminum foil insulated storage after two complete seasons of operation to see if any deterioration in insulation had produced heat flow rates greater than observed in our initial test when storage was first placed in operation. Test did not reveal any adverse change and heat flow and temperature differences measured for the various portions of the structure indicated an overall heat transmittance value at least as low as calculated from the manufacturer's published data.

A test was made on a storage constructed with a 3-layer pumice block wall to determine the transmittance of this type of material since only very meager information is available on the material. Tests indicated a transmittance of only 70 percent as great as expected from data given for one particular type of block manufactured in California. The 14-inch thick wall consisting of three 4-inch pumice block walls and two 1-inch spaces filled with vermiculite had an overall heat transmittance only slightly greater than a wall insulated with 4 inches of corkboard.

A test was made to determine the value of aluminum paint in reducing the heat load on a roof insulated with 4 inches of corkboard directly beneath the roof sheet. Results indicate that on an average 24-hour

basis, the black roof transmitted from 6 percent to 10 percent more heat to the storage than did the aluminum painted roof. It was noted that during the part of the day when maximum solar load was encountered, the aluminum painted roof surface temperature was usually 10 to 15 degrees lower than the black roof. This occurs during the autumn when maximum daytime temperatures of 65 to 75° F. were encountered.

Investigation of Heat Leakage through Floors - A considerable number of fruit storages in the Pacific Northwest have been constructed without insulation beneath floors placed on the ground and floor insulation has been considered a rather questionable investment. An investigation of the heat gain from uninsulated floors has shown that initially there is a period of stabilization when the heat flow from the earth beneath the floor slab is quite large due to the heat stored close to the floor surface. Even after a period of 2 to 3 weeks of operation, heat flow rates of 4 to 6 BTU/hr/sq. ft. of floor were observed. This rate dropped to 1 to 1.25 BTU/hr/sq. ft. a month later. In another storage the heat leakage rate was not as great initially but maintained a fairly high value over a longer period of time.

A definitely greater leakage around the edges of the floor near the outside walls has been observed; however, an installation where a foundary of 3 feet around the edges was insulated does not appear to hold sufficient promise to merit recommendation of such a practice.

The heat flow through uncovered portions of the floor has been observed to be about 10 times as great as those portions covered by boxes of fruit placed directly on the floor. This insulating effect by the commodity is gained at the expense of the product temperature, because in such instances the temperature of fruit in bottom layers is $1\frac{1}{2}$ to 3 degrees higher than that in boxes immediately above.

These observations indicate that the evaluation of floor insulation for fruit storages is quite complex. The study has not yet been carried far enough to yield a reliable answer to this question but will be continued.

Plans - Additional work determining cooling coefficients of apples in various packages will be made. A modified atmosphere storage test is under way with the Biological Sciences Branch to determine the applicability of this type of treatment for both Anjou and Bartlett pears. Additional work is planned on the floor heat leakage investigation. An investigation is planned on carbon-monoxide concentration in storages in the area using gasoline and L. P. gas-driven lift trucks.

- N. Proposal for Committee Consideration - Expand investigations to develop improved methods, equipment and facilities for precooling fruits and for storing apples and pears. It is proposed that this expansion will include biological, engineering and economic research on warehouse cooling, vacuum cooling, hydrocooling, tunnel cooling and other methods. Cooling rate studies should be expanded to obtain information on the time required to cool fruits packed in new type containers such as consumer size units, film bags and fiberboard boxes and on the effect of different load patterns. Data also will be obtained on rate of cooling in relation to surface of cooling units, volume and velocity of air or water for tunnel or hydrocooling, surface area of packages, and opening in packages. Attention will be given to the appearance and market life of the commodity as affected by rate of cooling, wetting in hydrocoolers, and drying in tunnel coolers or vacuum coolers. Economic studies will be made of the cost of the cooling operations and on difference in prices received for fruits precooled by various methods.

Publications

The Relation of Refrigeration to the Fruit Industry in Washington State. G. F. Sainsbury. Puget Sound Engineering. April 1954.

PREPACKAGING FRESH FRUITS - MRD

Progress and Findings - 1954 Recommendation, "Expand research on prepackaging to include development and evaluation of consumer packages and master containers for plums, prunes, peaches and grapes." (12/25)

Only limited research was undertaken during the past year on prepackaging fresh fruits. Observations were made on the arrival condition and trade acceptance of experimental shipments of Bartlett pears prepackaged in two-pound window cartons at the shipping point. Twenty of these cartons were packed in a master fiberboard shipping container and each carton held from 5 to 9 pears depending on their size. The appearance of the pears was generally excellent and sales were reported to be very good at the retail level. Some boxes showed considerable surface skin discoloration because the pears were too ripe, or because of looseness of pack. The dimensions of the cartons are planned to be reduced to make a tighter pack prior to future experiments. No work was undertaken on prepackaging peaches in 1954, although some technical assistance was given to peach shippers in Michigan and West Virginia, who were commercially experimenting with the packaging of peaches in unit containers.

Plans - It is planned to cooperate with the West Virginia Experiment Station next season to develop and evaluate packages and methods of prepackaging fresh peaches. In respect to other fruits, it is planned to cooperate with commercial fruit prepackagers in developing improved packages and evaluating the market acceptance of experimental containers.

- O. Proposal for Committee Consideration - Expand research on prepackaging to include development and evaluation of consumer packages for pears, plums, prunes, peaches, and grapes. Many fruits, such as plums, are carefully place-packed in conventional shipping containers only to be dumped out or repacked in consumer size packages in retail stores. Prepackaging of soft fruits at shipping point should reduce multiple handling, protect the fruit from bruising, maintain higher quality, and promote increased sales. A corporate grocery chain is definitely interested in obtaining more soft fruits prepackaged at point of shipment. The economic feasibility of service wholesalers pre-packaging winter pears and other fruits also should be investigated.

It is proposed that the prepackaging work be accelerated in order to assist in the development of suitable consumer packages and method of prepackaging various soft fruits, as was previously undertaken for apples. No known research is being undertaken by State agencies on prepackaging of soft fruits. It is planned that container manufacturers, growers and distributors of fruit will actively cooperate in undertaking the proposed studies.

DEVELOPMENT OF IMPROVED METHODS OF PREPACKAGING SHELLED NUTS - MRD

Progress and Findings - 1954 Recommendation, "Initiate work on the development of improved methods of prepackaging shelled nuts." (13/25)

No action has been taken on the economic or efficiency phases of this recommendation due to lack of personnel. See page 143 for report on quality phases of prepackaging nuts.

Plans - It is planned to initiate work on this study as soon as personnel is available.

- P. Proposal for Committee Consideration - Initiate work on development and economic evaluation of improved packages and methods of prepackaging shelled nuts for the purpose of increasing their salability and the efficiency of marketing and evaluate them. It is reported that the vacuum packed cans do not stimulate sales to the extent that might seem possible with transparent flexible packages. Little, if any, work on this problem has been done by State agencies. The proposed research is not a major undertaking and, with the cooperation of the tree nut marketing agencies, could be handled with relatively limited funds.

IMPROVED CONTAINERS AND PALLETS - FS

Progress and Findings - 1954 Recommendation, "Expand work on development of improved and cheaper shipping containers for deciduous fruits. (14/25)

Funds were not available for expansion.

Treatments of agricultural and other containers with oil and water-borne chemicals, now in progress for 4 years, show that good protection against decay, stain, and mold seems practical with a simple surface treatment. Among the promising solutions are cheap water-borne chemicals and certain combinations of these chemicals with water-repellent wax emulsions. The treatments are aimed at lengthening the service life for picking boxes used in harvesting fruit and vegetables and to protect other containers under severe field conditions. The most promising treatments, which included water repellents, also helped to keep box weight low by reducing rainwater pickup in the field.

Many organizations have in recent years adopted wood pallets for the more efficient storing, handling, and shipping of commodities. A Forest Products Laboratory publication outlines the development of the pallet industry and summarizes designs and specifications, presents results of research, and includes a glossary of terms and a selected bibliography. The results of several Laboratory testing programs are incorporated in this report. The data supplied have been a factor in increasing the annual use of the lower grades of lumber to over $1\frac{1}{4}$ billion board feet in recent years.

After tests on numerous materials, the Laboratory has found that a sandwich of four alternate layers of polyethylene film and kraft paper shows excellent promise as a satisfactory case-liner material to replace asphalt or wax-laminated kraft paper as a water-resistant liner for wood boxes. The latter materials have proved unsatisfactory in many boxes because of their brittleness when cold, since they may crack and admit moisture.

Drum and diagonal compression tests of boxes using paper-overlaid $1/8$ inch Douglas-fir veneer with light to medium degree of white-pocket indicated it was satisfactory as box material for shipping and storing of apples.

Q. Proposal for Committee Consideration - Expand research on new and improved materials for shipping containers and on the development of basic design data and performance standards for containers of various types. Cooperative work in packaging has resulted in the accumulation of much technical knowledge applicable much more generally than to the immediate projects for which it was done. This will be generally helpful in the urgently needed program of research on agricultural and related packaging and shipping problems. Specific lines of work would include (1) low-cost lumber from unpopular species for containers, including determination of how it can be used without excessive splitting, seasoned without inordinate warping, and sawn, sliced or otherwise machined rapidly, (2) pallets for farm crops and basic principles of pallet design, (3) design and performance standards for wood containers with special emphasis on use for agricultural products, (4) basic design data for use of fiberboard containers and their use for such agricultural products as vegetables, fruit and eggs, (5) evaluation of paper-overlaid veneer containers for nailing properties, gluing requirements, strength and serviceability for the agricultural container market, (6) design data for various materials for shipping drums, (7) design criteria for cleated panel boxes, (8) containers for storage of fruit, vegetables and other food stuffs need to be designed for use under refrigerated and other storage conditions and for bulk handling equipment, and (9) special treatments for paper and paperboard to improve wet and dry strength in container use.

Plans - Work will be continued during the coming year on fruit and vegetable containers, pallets, fiberboard boxes and crates.

Publications

The Wood Pallet Industry, Its Development and Progress Toward Standardization. Forest Products Laboratory Report No. 1957, 1953.

EVALUATION AND DEVELOPMENT OF IMPROVED AND CHEAPER CONTAINERS - MRD

Progress and Findings - 1954 Recommendation, "Expand work on the development of improved and cheaper shipping containers for deciduous fruits." (14/25)

Research work to develop improved and cheaper shipping containers for fresh plums, winter pears and Bartlett pears was given some increased emphasis during the past year.

Plum containers - Considerable work was undertaken during 1954 on the development of improved shipping containers for fresh plums. In preliminary tests, nine types of experimental containers were packed with fresh plums in California, and shipped to the New York auction market in comparison with conventional containers. These included fiberboard, wirebound and paper laminated veneer type containers. Three fiberboard containers showed the most promise and they were selected for further evaluation. The most successful of the three types of fiberboard containers tested during 1954 appeared to be a folding full telescope fiberboard box. It was a very sturdy container with four thickness of fiberboard on each side of the box. It was also the most expensive, costing about 34 cents a box. In all three containers, the plums were place-packed rather than jumble-packed, and the top layer was row-packed on a fiberboard tray, which rested upon the place-packed plums. The fiberboard tray maintained alignment of the row-packed plums exceedingly well, making the package quite attractive to the auction market buyers. The weight of the tray still bruised some of the plums on which it rested, and some additional work needs to be done to develop a method of packing plums or a different type tray which will reduce this slight bruising. A regular slotted box with a tear-tape lid, which was packed in an inverted position, was the second most successful experimental container evaluated. It was a sturdy container and its chief disadvantage was that it could not be opened and closed without it being obvious that it had been opened. Buyers lack confidence in buying fruit in containers which plainly show that they have been opened for inspection. This container was several cents cheaper than the sturdy folding telescope container and it would be more efficient to set up and pack. The third type container tested was not as sturdy as the above two boxes because it was a two-piece telescope box with each piece made of single wall fiberboard. It was the cheapest, costing only about 23 cents and might be used satisfactorily under some conditions.

All of the experimental shipments were made to auction markets and, in contrast with results in 1953, they met with very little resistance from buyers. Although the plums shipped in the experimental containers were heavily discounted during the 1953 tests, they were not discounted more than a fraction of a cent per pound in the 1954 tests. There is definite evidence that the trade is learning to accept and appreciate the use of fiberboard containers for fruit, primarily because they are easier to handle and because of reduction of severe bruising to the fruit.

This work was carried out under contract with the California Grape and Tree Fruit League, which secured excellent cooperation from container manufacturers, plum growers and shippers, transportation agencies, and terminal market receivers.

Pear containers - In cooperation with the Oregon-Washington-California Pear Bureau, a project similar to the plum container project was undertaken. A total of 29 test shipments of pears was made in fiberboard experimental boxes during the 1953-54 winter season. The Oregon-Washington-California Pear Bureau, in cooperation with the pear shippers and container manufacturers, assumed the responsibility for the development of the experimental containers and the packing and shipping of the pears, and Department personnel evaluated the market acceptance of the pears in the experimental boxes.

Five types of fiberboard boxes were observed: (1) Double-wall; (2) single-wall with a full liner; (3) single-wall with a U-liner on two sides and bottom; (4) single-wall with double-wall liner on four sides and bottom; and (5) single-wall with cell dividers. The double-wall box and the single-wall box with double-wall liner appeared to be the most substantial of the five types. The single-wall fiberboard box with cell dividers, which was observed on only one shipment, showed more corner crushing than the other types. However, no extensive, serious container failure was found in any of the test shipments. Generally speaking, the containers appeared to protect the pears satisfactorily. Corner crushing, which was infrequent, probably was due to shifting of the load in transit, forcing the containers out of alignment. Tops of the containers were usually depressed because of the slackness of the pack. Most of the receivers and wholesalers who inspected and appraised the pears packed in experimental fiberboard shipping containers were quite favorably impressed with the container's ability to minimize injury to the fruit, although they were apprehensive over the stacking and trucking capabilities of the fiberboard boxes. With the exception of retailers, there was general disapproval of the slackness of pack prevalent in most of the containers. Retailers who handled the experimental containers were very pleased with the container's ability to reduce injury to the pears.

Plans -

Plum containers - No additional research is now planned to further refine and test improvements in the experimental plum containers. It is believed that, on the basis of the research completed, the plum industry can proceed to try out the experimental plum containers on a commercial basis. It is to be expected that further work would be helpful and some technical assistance may have to be given plum shippers in helping them adapt their packing operations to the new plum containers. It is possible that, upon further trial under commercial conditions, additional research may be needed to solve problems not yet apparent.

Pear containers - Considerable work is currently being undertaken in evaluating new experimental containers for winter pears. Approximately 20 experimental carloads of winter pears were packed and are being shipped under commercial conditions under a contract with the Oregon-Washington-California Pear Bureau during the 1954-55 shipping season. Both of the Oregon and Washington Experiment Stations are cooperating on this project by making cost studies in pear packing plants, and packaging research personnel of the Transportation and Facilities Branch will evaluate the arrival condition and market acceptance of these winter pears packed in experimental containers during the 1954-55 shipping season. Transportation specialists will also develop and evaluate suitable loading patterns and devices. It is not known whether additional work will need to be undertaken on the development and evaluation of winter pears until the results of the 1954-55 tests are available.

During the summer of 1954, two preliminary test shipments of Bartlett pears packed in fiberboard, wirebound and combination wood and paper veneer containers were made under the auspices of the California Advisory Board for the Promotion of Bartlett Pears. These containers are generally cheaper than the conventionally used wooden box and they also show promise of reducing bruise damage to the pears, and more work is planned to be undertaken next year.

- R. Proposals for Committee Consideration - Accelerate the expansion of work on development of improved and cheaper shipping containers for deciduous fruits. Development and evaluation of improved or cheaper shipping containers for grapes, peaches, apricots, and apples should be initiated as soon as possible. Tremendous interest is shown by shippers and distributors in the development of new containers and expansion of the work ought to be accelerated, if at all possible.

The objectives of this work are to develop low cost containers that are efficient to pack, refrigerate, and ship, and that will command favorable trade and consumer acceptance. Containers are evaluated from the standpoint of (a) the amount and cost of labor required to set up and pack the container as well as to handle the container throughout the entire marketing system; (b) the effect of the container upon the appearance and salability of the fruit; (c) the damage, waste, and spoilage of the fruit occurring throughout the marketing system as a result of the container; (d) the operating efficiency in packing and handling containers in the packing sheds and in the terminal markets; and (e) the effect of the containers upon the net returns to growers and shippers of these fruits.

From the viewpoint of physical handling, consideration must be given to methods of loading and refrigeration of experimental containers in railroad cars and the possibility of precooling them efficiently before shipment. Major problems are the bruising of soft fruits from transit shock and vibration, and lack of adequate refrigeration of some commodities because of poor air circulation. Studies should be made to determine types of packages and methods of loading in the car that give the best results in minimizing mechanical damage and at the same time providing for adequate circulation of air through the load.

Container manufacturers are active in the development of new containers. Therefore, these studies will be primarily concerned with the evaluation of newly developed containers in close cooperation with container manufacturers, growers, shippers and distributors of fruit. Little, if any, work has been done by State agencies. In view of the cost-price squeeze facing fruit growers and shippers, this work should be expanded as rapidly as possible.

Publications

Trade Reaction to Winter Pears Packed in Fiberboard Boxes. Donald R. Stokes and Russell L. Hawes. August 1954. U.S.D.A. processed.

IMPROVE EASTERN APPLE HANDLING METHODS - MRD

Progress and Findings - 1954 Recommendation, "Initiate a study to improve Eastern apple handling methods." (21/25)

This study was to be undertaken jointly with Cornell University Agricultural Experiment Station. Discussions with officials at the Experiment Station revealed that they were unable to undertake this work due to lack of personnel. In addition, personnel were not available in the Department to be assigned to this study. As a result the study was not started.

- S. Proposal for Committee Consideration - Initiate a study in the Appalachian and other Eastern apple areas to improve handling methods in off-farm storages and packinghouses. Research completed in Pacific Northwest apple houses provides a fund of valuable data and information, including standard time values for performing handling operations by different work methods, much of which could be applied to operations in Eastern houses. However, these data and their analysis in published reports apply to houses handling 100,000 boxes or more

of fruit annually. They should be interpolated and where necessary supplemented for application to smaller Eastern houses, many of which handle only 10,000 to 15,000 boxes of fruit annually. Techniques also need to be developed for applying these data to the handling operations in individual houses. It is proposed that this study be undertaken in cooperation with the Agricultural Experiment Station of one of the leading apple producing States in the East and that the work be closely integrated with State marketing service and educational programs in order to maximize prompt and effective use of the findings and methodology.

MATERIALS-HANDLING RESEARCH IN PACIFIC NORTHWEST APPLE PACKING AND STORAGE HOUSES - MRD

Work was continued in preparing for publication the findings resulting from the materials-handling research in Pacific Northwest apple packing and storage houses performed under contract by the Washington State Apple Commission. The contractor's final report is the basis for a series of five semitechnical reports plus a summary. The first of the series of reports was released in June 1953. The second report, which covers innovations in handling methods and equipment, was submitted for clearance May 1954. The third report covering the handling of empty boxes was published June 1954. The fourth report, which covers the effects of different types of equipment on storage space utilization, is in manuscript form and the fifth report, covering comparative plant-wide materials-handling costs, is in preparation. When these five reports have been completed a popularized summary of their content will be prepared.

Plans - In providing technical assistance to individual plant operators in selecting more efficient methods and equipment for handling fruit, one of the problems that will be encountered is that only a few apple houses in the Appalachian and other Eastern apple areas currently are using methods and equipment for which base data on labor and equipment requirements are available. In making comparisons and determining possible savings in individual apple houses in the Appalachian and other Eastern apple areas, it therefore will be necessary to conduct a limited number of time studies to build up data on methods and equipment now being used. These data then could be compared with standard data from published reports, adjusted to individual plant condition. In the beginning, joint research-educational or research-service projects will be needed to provide technical assistance to individual plants and to develop methodology for use by extension and service workers. Plans for the initial project of this type are being developed.

Publications

Handling Empty Apple Boxes in Pacific Northwest Packing and Storage Houses. D. Loyd Hunter, Raoul S. Duerden, Francis Kafer, and Joseph F. Herrick, Jr. Marketing Research Report No. 71. June 1954.

Innovations in Apple Handling Methods and Equipment. Earl W. Carlsen, Raoul S. Duerden, D. Loyd Hunter, and Joseph F. Herrick, Jr. Marketing Research Report No. 68 (being reviewed).

Methods of Apple Handling. Fruit and Vegetable Review. December 1953.

Handling Costs of Apples Reduced by Lift Trucks. Industrial Refrigeration. October 1953.

Apple Handling Savings. Food Engineering. October 1953.

MORE EFFICIENT WORK METHODS AND EQUIPMENT FOR SORTING, SIZING, AND PACKING APPLES - MRD

Progress and Findings - The second year's work has been completed by the Washington State Apple Commission under provisions of an AMA contract, as amended. Based on research performed during the first year a prototype sorting table was built and tested. This sorting table incorporated new principles which were not used on any of the commercially available sorting tables. It is known as the "float-roll" sorting table and is so designed that the fruit is carried on top of rolls past the workers performing the sorting operations. Also the table is so constructed that rotation of the fruit can be varied independent of the forward movement of the apples. Simple adjustments permit the fruit to be turned over in front of the inspectors and moved past them at speeds which permit optimum sorting efficiency. Costs of sorting apples with this table were estimated at \$29 per 1,000 boxes, which is a saving of \$16 per 1,000 boxes or 35 percent over the most commonly used sorting table in use prior to undertaking this research. Research results indicate that the "float-roll" table does not cause a significant increase in bruising damage. An application for public patent covering the "float-roll" sorting table is being made. A new type sizing table was also developed. Although the new table does not permit as many sizes to be run as some of the presently used equipment, it has considerably more capacity. The variability in the sizing of the fruit was slightly greater on the new sizer, which sizes the fruit by external dimensions, than when using weight type sizers. However, it holds considerable promise in reducing costs of sizing fruit.

Under provisions of a second amendment to the contract, the contractor will construct and test both stationary and portable accumulator-packing station devices which can be used with the new type sizing table or with the commonly used sizing equipment for hand packing boxes or cartons and with devices and equipment for prepackaging and mechanically packing fruit. The amendment also requires the development and testing of a system of return flow belt conveyors which will permit manual resizing of fruit. In addition the contractor will test individual pieces of equipment developed by inserting them in old type packing lines and by combining them in a newly constructed packing line. Tests will also be run to determine the influence of the newly developed equipment on "other" packing line operations and on the layout of the packing room itself.

Plans - Since the sorting phase of this research has been completed and the final report on this work has been submitted by the contractor, it is intended to prepare and release a Department publication on apple sorting operations during the current fiscal year. Additional work has been contracted which will complete the research covering sizing, packing and other packing line operations. The contractor's final report on this part of the research is due August 31, 1955. Material from this latter report will be released during the next fiscal year. It is also planned to produce a motion picture on packing line operations. This production is to be undertaken on a contract basis with provision that it be completed by July 31, 1955. The last phase of the efficiency studies in Pacific Northwest apple houses is planned for the 1955-56 season. This work will cover the development of new and improved layouts and designs for packing and storage houses.

Publications

Speedier Sorting. William H. Elliott and Joseph F. Herrick, Jr.
Marketing Activities. April 1954.

VISUAL INSPECTION OF PRODUCTS FOR SURFACE CHARACTERISTICS IN GRADING OPERATIONS - MRD

Progress and Findings - 1954 Recommendation, "Initiate research to develop more efficient work methods and equipment for hand sorting peaches, plums, pears and tree nuts." (22/25)

This research has not been initiated because resources and personnel were not available for the current fiscal year.

- T. Proposal for Committee Consideration - Initiate research to develop more efficient work methods and equipment for sorting peaches, plums, dried fruits, and tree nuts. This research should include studies to determine the optimum speeds of translation and rotation for sorting peaches, plums, dried fruits, and tree nuts and to develop improved sorting tables which will minimize labor requirements, bruising, and mechanical injuries. Sorting these fruits and nuts into grades requires relatively large amounts of labor during periods when other operations also are drawing upon the available labor supply. It is therefore of interest to make this labor as effective as possible. This study would expand and apply visual inspection principles developed primarily under laboratory conditions and would encompass additional variables found only under conditions as they exist in fruit and nut packinghouses.

PEAR RIPENING ROOMS ON WHOLESALE MARKETS - MRD

Progress and Findings - 1954 Recommendations, "Initiate research to develop plans for winter pear ripening rooms on city wholesale markets." (23/25)

This work was not initiated due to shortage of funds and personnel.

LOADING METHODS FOR PEACHES IN BASKETS - MRD

Progress and Findings - Transportation tests were undertaken during the 1954 peach shipping season looking toward improved loading patterns for peaches shipped by rail from Georgia and South Carolina. Breakage of the containers in transit and bruising of fruit have been the cause of much loss and down-grading of the fruit. Conclusive results were not obtainable from the limited number of tests made (45), but preliminary indications were that the crisswise offset method of loading was only slightly better than the conventional end-to-end offset method mostly used. However, on a limited number of tests in which the baskets were alternately inverted, container damage was much lower than either of the other methods tried.

Plans - The work will be continued in the 1955 season.

TRANSPORTATION OF APPLES IN THE APPALACHIAN AREA - MRD

Progress and Findings - A study has been completed on the extent and characteristics of transportation in the Appalachian apple-producing area. It shows that apple shippers in the area prefer truck transportation. Shipments by truck approximated 92 percent of the total apple sales; shipments by rail, 8 percent. Apples move from this area by truck as far as Dallas, Texas--a distance of 1,400 miles. Better and faster service and lower rates were mentioned by shippers as two of the principal advantages to be obtained from truck transportation. Two of the principal advantages of shipping apples by rail as stated by shippers were: (1) The greater reliability of rail carriers in contrast to that of some truck operators; and (2) the uniformity of railroad freight rates. The study's comparisons between truck and rail and the survey of shippers' reasons for preferring a particular mode of transport were made as a means of pointing up possible changes in transportation charges and services which would improve marketing efficiency.

Publications

Transportation of Apples in the Appalachian Belt, 1952-53. James R. Snitzler. August 1954. USDA Mimeo.

- U. Proposal for Committee Consideration - Initiate studies of the extent to which fresh fruits and vegetables move by rail or truck and the factors such as rates and service that bring about changes in mode of transportation, with special emphasis upon studies of (1) the potentialities of motor truck transportation from Pacific Coast States to Midwestern and Eastern markets, and (2) possibilities for improving transportation service, methods, and facilities in order to increase the efficiency of moving apples from the Pacific Northwest. This analysis would begin with the relative and absolute amounts of fruits and vegetables hauled by rail and by truck, respectively, and the respective distances, based on data on unloads in major markets and on shipments out of Florida, Texas, and California, and would include any important factors which help to account for changes in the absolute or relative volume of traffic handled by a given mode of transportation. These last-mentioned factors are illustrated by the rising importance of frozen fruits and vegetables. The study would be an up-to-date and more comprehensive sequel to a study of rail-to-truck diversion which the Department based on a comparison of 1948 and 1951. The new study would be useful to the Department and shipper groups in rate litigation and would be of interest to carriers and shippers generally.

The Pacific Coast aspects of the foregoing analysis would serve as groundwork for a study of the potentialities of motor truck transportation of fresh fruits and vegetables from Pacific Coast States to Midwestern and Eastern markets. Because of the high level of railroad rates and further increases threatened, West Coast shippers have proposed that a study be made to determine the costs and changes for the transportation of these commodities to Midwestern and Eastern cities, service factors, present level of traffic westbound for the return haul, and the limitations upon volume movement, particularly to the area east of the Mississippi River. Consideration would also be given to comparable railroad rates and services.

Special attention would be given to the transportation of Washington and Oregon apples. This study would be similar to the recently completed one on transportation of apples in the Appalachian belt. Emphasis would be placed upon the extent and type of truck and rail transportation, as a means of pointing up possible changes in transportation service, methods, and facilities which would improve efficiency. In addition, the relative importance of factors affecting shippers' choice of carrier, importance of initial and backhaul traffic in the truck transportation of apples, and the rates and charges for the movement of this traffic would also be studied. It is believed that more effective competition between carriers would be encouraged by such information.

- V. Proposal for Committee Consideration - Initiate studies on transportation methods and costs on processed fruits and vegetables from the North Pacific Coast to Midwestern, North Central and Atlantic Seaboard Markets. This study would explore the possibility of reducing transportation and other distribution costs of processed fruits and vegetables from the North Pacific Coast area. Increased freight rates and related transportation costs have created a serious marketing and distribution problem to North Pacific Coast canners and packers of fruits and vegetables in competing with other producing areas. A study of the current transportation rate structure, operating costs and distribution practices for various producing regions to markets normally served in the Midwestern, North Central and Atlantic Seaboard territories is needed. Effects of alternative methods of transportation on marketing and distribution practices should be undertaken. The Northwest Canners Association and other organizations have requested the U.S.D.A. to undertake research on the marketing, handling, distribution and transportation factors affecting the competitive position of North Pacific Coast processors of fruits and vegetables.

EFFICIENCY IN FRUIT HANDLING - MRD, California Agricultural Experiment Station

Progress and Findings - In this cooperative project the work for 1954-55 consists mostly of preparing for publication several reports based on studies of grape packing in California.

A final report on the entire project which has considered the efficiency of several operations involved in assembling and packing apples, pears, olives and grapes also will be compiled this year. This report may be in the form of a handbook for packinghouse operators which would suggest ways and means of reducing the cost of performing certain packing functions and services. Also the experience gained in carrying out this project will be summarized for the benefit of others who may undertake similar types of cost and efficiency research.

Completion of these reports will mark the final phase of this work.

Plans - No further work is planned for deciduous fruits.

Publications

Efficiency in Fruit Marketing: Wage Plans and Efficiency in Grape Packing, B. C. French and L. L. Sammet, California Agricultural Experiment Station. In process.

Efficiency in Fruit Marketing: Picking, Assembling, and Grading Sevillano Olives, Gordon R. Sitton and L. L. Sammet, California Agricultural Experiment Station. Mimeo Report No. 155, June 1953

MATERIALS-HANDLING RESEARCH IN THE STORES AND WAREHOUSES OF WHOLESALE PRODUCE DISTRIBUTORS - MRD

Progress and Findings - Materials-handling operations in stores and warehouses are responsible for a significant part of the cost of marketing produce. The research reported here is being carried out to develop data and to determine for all kinds of packages of fruits and vegetables the most efficient types or combination of types of equipment for performing all materials-handling operations. In order to realize the full benefits from this research, it is necessary to use the results of materials-handling studies to develop the types of layouts and designs of facilities to obtain optimum environmental conditions in which the materials-handling operations should be performed.

During the past year data obtained earlier was reviewed and analyzed. Results of this review revealed that additional time studies are needed to develop more reliable data for receiving, intrawarehouse handling, and loading out operations.

Data already developed indicate that fruit and vegetable dealers can make significant savings on materials-handling operations by shifting to some of the newer and more advanced types of materials-handling equipment.

Plans - This work will be continued with emphasis being placed on completing the field work on materials-handling operations during the current fiscal year. This will involve making time studies, as well as other industrial engineering studies, of the methods and equipment used for handling rigid and nonrigid containers in the stores and warehouses of wholesale fruit and vegetable dealers. A final report should be completed during the 1955 fiscal year.

- W. Proposal for Committee Consideration - Initiate research to develop improved layouts and designs for the warehouses of service wholesalers of fruits and vegetables. Improved layouts and designs for the warehouses of service wholesalers of fruits and vegetables should permit maximum efficiency of operations based on the types of materials handling and other equipment used, the amount of space required in work stations and for storage, the width of aisles, and the amount of space needed in relation to volumes handled. In developing improved designs, attention also would be given to structural requirements, refrigeration needs, and construction costs. About five warehouse layouts of different sizes and arrangements would be developed as an aid to wholesalers in planning new facilities or in remodeling existing structures. Numerous requests from service wholesalers for warehouse plans insure industry cooperation in the proposed project.

IMPROVED HANDLING OF PRODUCE AND FROZEN FOODS IN RETAIL FOOD STORES - MRD

Progress and Findings - Time and motion techniques and other management techniques are being used to increase labor productivity and reduce costs through improved methods, equipment, materials, and layout of produce and frozen food departments in service and self-service type retail food stores. The research is being conducted in cooperation with several retail organizations in different areas of the United States. Current methods of handling have been analyzed and improvements developed. Some of these improvements are currently being tested. The research will continue for the remainder of the fiscal year.

Publications

Frozen Food Handling Efficiencies at Retail. Article released in Marketing Activities. Jan. 1954.

Some Comparative Methods of Packaging Potatoes and Onions at the Point of Distribution. Marketing Research Report ____

Improved Methods of Receiving, Price Marking, and Displaying Citrus Fruit. Marketing Research Report ____

DEVELOPING BASIC DATA FOR PLANNING WHOLESALE PRODUCE MARKET FACILITIES - MRD

Progress and Findings - A manuscript covering designs of store buildings for produce wholesalers, sales sheds for farmers and truckers, and other types of facilities usually constructed on wholesale produce markets is being reviewed for publication. This manuscript should serve as a manual for market planners.

In November 1952, in cooperation with The National Association of Produce Market Managers, a study was initiated to obtain data on the operations of markets of various sizes and types. This study was completed during the 1954 fiscal year. Some 45 wholesale produce markets were visited and detailed analysis was made of the management, operating expenses, and income. A report on this work is in process. The results of this study should help market managers to find ways of reducing operating expenses, increasing income, and to do a better job of managing their markets.

During the current fiscal year work was started on revising a manuscript on types of ownership and methods of financing wholesale produce market facilities. This manuscript started in July 1950 is being brought up to date and otherwise revised to allow for publication early in 1955.

The principles of desirable ownership of a produce marketing facility will be enumerated and different types of ownership will be appraised in light of these principles in an effort to provide a guide to the selection of the type or combination of types best suited to a specific market.

The report will appraise the several types of market ownership, defining each type, giving advantages and limitations of each, showing examples, and outlining processes of organization, require-

ments for organization, description of enabling legislation needed, etc. Included in the appraisal will be ownership by private corporations, combinations of corporations, public benefit corporations, state-owned markets, municipal markets, cooperatives, etc.

Types of items that should be financed by a market will be discussed, and a detailed description of how markets can be financed will be included in the study. Also to be discussed will be a classification of investors, where funds to finance markets can usually be found, and types of financial instruments usually used in the financing of a market facility.

Plans - Work in this general area will be continued.

- X. Proposal for Committee Consideration - Expand research to develop basic data for use in planning wholesale produce market facilities in specific localities. Such research should include work on:
- (1) Improved layouts and designs for various types of market structure;
 - (2) amount of space required in various types of market structures in relation to volumes handled;
 - (3) the extent to which team track operations can be efficiently substituted for warehouse operations on the larger terminals;
 - (4) market operating expenses on various sizes and types of facilities;
 - (5) types of market ownership;
 - (6) methods of financing market facilities;
 - (7) the proper location of markets; and
 - (8) other factors that effect the efficiency of market operations.
- It is contemplated that the results on this research would be published in a series of reports having the general title "How to Plan Market Facilities." The background data and material developed should enable the Department staff to do a more effective job of planning and promoting the construction of improved market facilities. (See page 204).

Publications

Wholesale Produce Markets -- Management, Operating Expenses, and Income. J. S. Larson. Marketing Research Report _____

MARKET DEVELOPMENT

EFFECT OF RETAIL MERCHANDISING PRACTICES ON CONSUMER DEMAND FOR FRUITS AND VEGETABLES - MD

Progress and Findings - 1954 Recommendation, "Expand studies of effect of retail merchandising practices upon sales of fresh fruits and vegetables." (15/25)

Evaluation of the effect of various merchandising practices on the sales of and consumer demand for selected agricultural products is currently being carried out in a sample of stores in Pittsburgh, Pennsylvania. The expansion of this work results from recommendations of the Deciduous Fruit and Tree Nut and Vegetable Advisory Committees last year. Products for which merchandising tests are being conducted include, among others, potatoes, fresh mushrooms, pears, grapefruit, carrots and bananas. Carrots, pears and bananas have been included in these tests at the request of the chain store organization cooperating in this research. Within recent years new merchandising techniques have been introduced which the trade is interested in appraising as to their effectiveness in increasing sales in different types and sizes of retail outlets in various sections of the country. The ultimate objective of this research is to promote wider use of successful marketing techniques as a means of promoting increased consumption of fruits and vegetables.

Plans - This work will be expanded to additional areas and additional commodities during the coming year.

FACTORS INFLUENCING CONSUMERS IN PURCHASING FRUITS AND VEGETABLES - MRD

Progress and Findings - 1954 Recommendation, "Initiate a study of the relative importance of factors used by consumers in identifying quality of fresh and processed fruits and vegetables as a basis for improvement in grades and standards." (17/25)

This work was not initiated during the current fiscal year because neither personnel nor funds were available.

Plans - Negotiations aimed at activation of a study in 1955 will be opened with North Carolina Agricultural Experiment Station and possibly other agricultural experiment stations qualified to conduct this work on a cooperative basis.

DETERMINATION OF CONSUMER AND TRADE PREFERENCE FOR FRESH GRAPES IN IMPORTANT MARKETS OF THE UNITED STATES - Matching Funds (OES) and Ext. Service

Progress and Findings - Analyses of factors related to auction price premiums for fresh Thompson Seedless and Tokay grapes were completed during 1953, and a manuscript prepared for publication. The statistical study was based on data obtained by the California Agricultural Extension Service at the New York auction market during 1951 and 1952.

Berry size, mode of shipment, and brand name were the dominant variables contributing to the "explanation" of price premiums in each year and for both types of grapes. Overall quality rating, stem condition, color, and Balling-acid ratio were significant factors in selected formulations. Among the market variables, daily volume of sales, daily price level, and day of the week appeared significant in certain equations. The daily analyses were considered exploratory, and little by way of substantive results can be claimed for them.

General observations from the auction study and some of the results of the price analyses have been used by the Extension Service in grower meetings. Perhaps more important, these results are serving as a basis for a series of field tests to check the effects of packing and marketing conditions on grape quality and price.

Plans - With the publication of the manuscript listed below, no further work is contemplated at the present time.

Publication

Factors Related to Auction Price Premiums--Fresh Thompson Seedless and Tokay Grapes. Lee, I. M. and Richardson, H. B. Calif. Agr. Exp. Sta., Giannini Foundation Mimeographed Report No. 160.

RED SOUR CHERRIES IN HOME PIE BAKING AND OTHER HOME USES - MD

Progress and Findings - In recent years, an increasing proportion of the canned vegetables and fruits have been packed in the smaller No. 303 cans rather than the No. 2 size container. Although this change may not have created dissatisfaction for products which are served as portions, the situation is quite different in the specific case of those canned fruits used in such receipes as pies, which require a certain minimum volume to make an adequate fill.

In this connection, the National Red Cherry Institute, for example, has informed the Department that their test kitchens indicate that the No. 303 can does not make a suitable cherry pie. However, during the last year more and more cherries have been put into No. 303 cans. Except for scattered complaints, growers and processors do not know how consumers feel about the new size. Movement of both consumer size cans (No. 303 and No. 2) of red sour cherries has been slow this year, and at present the industry does not have sufficient information about the causes of the reduced sales to permit them to take efficient immediate action.

The Cherry industry, therefore, feels that a study which would provide data about consumer habits and attitudes on the following items would be of the utmost value to the packers and merchandisers:

1. Purchases of pies.
2. Home baking of pies.
3. Relative popularity of various fills.
4. Other uses of canned and frozen cherries.

Plans - The study will be conducted in three comparatively large cities--using a cross-section sample to represent homemakers in those cities. It is expected that interviewing will take place during February 1955.

- Y. Proposal for Committee Consideration - Initiate a retail store market test in one or more selected cities to determine the relative sales of canned red sour cherries in No. 303 cans and No. 2 cans. This sales test would be a controlled experiment with respect to prices of the product and the size and arrangement of displays of canned cherries in the test stores. A sufficient period of time would be allowed to obtain the effect of repeat purchases on sales of the two can sizes in order that some measurement could be obtained of consumer preference between the No. 2 and the No. 303 can.

AN APPRAISAL OF THE COMMERCIAL ACCEPTANCE OF DEHYDRO-FROZEN FRUITS AND VEGETABLES - MD

- Z. Proposal for Committee Consideration - Initiate studies to evaluate commercial acceptance of dehydro-frozen fruits and vegetables. For the past several years, the Western Utilization Research Branch has cooperated with various industry groups by making available test batches of dehydro-frozen apples, apricots, pimentos, peas and carrots. It appears that these dehydro-frozen fruits and vegetables have had varied success in commercial test use. There is a real need for an over-all evaluation of the dehydro-frozen process. This would include interviews with a number of concerns having had experience with dehydro-frozen fruits and vegetables and an over-all appraisal of whether the process appears to have merit in the future. This work has been requested by the Western Utilization Research Branch as a guide to further dehydro-frozen research on fruits and vegetables.

COLLECTION, ANALYSIS AND DISSEMINATION OF MARKET DATA

MEASUREMENT OF AND FACTORS AFFECTING RATE OF MOVEMENT OF APPLES - MRD
Northeastern Region (NEM-())

Progress and Findings - 1954 Recommendation, "Expand studies to develop feasible methods for reporting on a current basis the rate of apple movement into consumption." (1/25)

Analysis of data on factors affecting apple sales which were collected in 8 markets last year is progressing at the New York and Virginia Agricultural Experiment Stations. The purpose of the analysis is to measure the relative effect of several factors that are believed to exert a strong influence on rate of movement of apples into consumption. During the current year the market coverage of the project has been reduced to 3 markets--Atlanta, Pittsburgh, and Boston. The number of cities was cut back so that a more thorough job of observation and enumeration could be done in the markets. A record of inventories and total sales of apples is now being obtained in each store in the sample. This record of actual sales can be compared to estimated rate of movement based on sales per 100 customers. Emphasis is continuing to be directed primarily toward the factors affecting changes in rate of movement of apples into consumption. In the current phase of this work, however, attention also is being given to the possibilities of developing a practical and reliable method that may be employed in the measurement of rate of movement.

A preliminary review of the statistical methodology and comparative costs of different methods of reporting rate of movement data was made by the USDA. This review indicated that it would be more efficient to collect such data for a number of commodities than for a single commodity, and that complete store audits taken weekly for the commodities studied may yield more reliable data on total rate of movement than other alternative methods.

Plans - Cooperation with the Northeastern Regional Committee will be continued. It is expected that primary emphasis next year will be given to analysis of the data already collected and the preparation of a comprehensive report of findings.

- AA. Proposal for Committee Consideration - "Expand studies to develop feasible methods for reporting on a current basis the rate of movement of farm products (including apples) into consumption, with major emphasis on testing the statistical reliability and costs of collecting the data in alternative ways."

ESTIMATING TIME OF MATURITY OF FRUIT - AES

Progress and Findings - 1954 Recommendation, "Initiate a study on estimating time of maturity of fruit crops." (4/25)

Funds were not available to start work on this project.

- BB. Proposal for Committee Consideration - Initiate a study on estimating time of maturity of fruit and nut crops. The earliness or lateness of the maturity of fruit and nut crops has an important bearing upon the marketing of the crop and the prices received. Dependable methods of estimating the time of maturity and harvest, together with information on the rate of harvest, are needed by the industry in its marketing operations. Competition or the lack of competition between areas has a large influence on the method of marketing and the prices received. Information on maturity would assist in the orderly marketing. Wholesalers, transportation officials, marketing officials and retailers need information on time of marketing in the handling of the perishable crops such as fruits. At present, an attempt is being made to indicate the approximate time of maturity and harvest of each crop in respective competing States or areas. The present information, for the most part, consists of a summary of prevailing opinions. Exploratory studies should be made in a few States representing the various regions and on two or three crops. Initially, the work would require the assembling of considerable information on blooming dates, daily temperatures, related weather information and time of maturity of fruit and nuts.

METHODS OF ESTIMATING PRODUCTION OF FRUITS - AES

Progress and Findings - 1954 Recommendation, "Expand work on the improvement of present methods and initiate a program to develop additional methods of estimating fruit and nut crops." (5/25)

No work was undertaken on this project. The lack of funds was the limiting factor.

Plans - Two or three units outside of California, possibly in Washington, Michigan, and South Carolina, should be established to conduct research on the improvement of present methods and to explore the feasibility of estimating fruit production by objective methods and other means than those now employed.

CC. Proposal for Committee Consideration - Expand the work on the improvement of present methods of estimating the production and utilization of fruit and nut crops and initiate a program to develop additional methods. Growers, processors, marketing and transportation officials, wholesalers and others are desirous of having forecasts or estimates more dependable than is now possible with present methods. In addition to the small amount of work which has been carried on in California (largely with industry and matched funds), it seems desirable to expand the work to determine the possibilities and limitation of the present methods, and to explore additional methods. The work should be undertaken with various fruit and nut crops outside of California where cultural and growing conditions are different.

USE OF FROZEN FRUITS BY THE INSTITUTIONAL TRADE - MRD

Progress and Findings - 1954 Recommendation, "Initiate a study of the rate of movement of fruits and fruit products to institutional users."
(20/25)

A survey of the use of frozen foods by restaurants and cafeterias is being conducted under contract by a private research agency. Although the primary purpose is to obtain a picture of the use of frozen foods in public eating places, information also is being collected on the use of the corresponding fresh and canned items. Since there is a seasonal difference in the relative positions of all these foods in the restaurant industry, records of purchases are being obtained for two periods of 4 weeks each, one in the summer and one in the winter. In addition to the purchase data, the reasons for use and nonuse of specific frozen items have been obtained from approximately 500 operators of restaurants and cafeterias representing a cross section of the industry. The results of this study are in the process of publication.

Surveys are being made of the quantities of the individual fruits used in the fresh, frozen, and canned forms by (1) pie bakers, (2) preserve manufacturers, and (3) ice cream manufacturers. The surveys of pie bakers and preserve manufacturers have been completed. Replies have been received from over 90 percent of the pie bakers and 80 percent of the preserve manufacturers. It is estimated that firms included in this sample represent some 80 percent of the total volume. The survey of ice cream manufacturers is in progress with similar cooperation in prospect. Progress reports have been prepared for both the pie bakers and preserve manufacturers surveys. Final reports of these surveys are in the process of publication.

A pilot study has been undertaken to determine the feasibility of obtaining from distributors' records the monthly movement of selected frozen foods into retail outlets. The study includes two cities, Philadelphia and Washington, D. C., and will cover a six-month period. The results will be reviewed with distributors.

Publications

Purchases of Frozen and Canned Foods by Urban Families as Related to Home Refrigeration Facilities. H. W. Bitting. Marketing Research Report No. 60. February 1954.

Availability and Display of Frozen Foods in Retail Stores in Washington, D. C. Dehard B. Johnson. Marketing Research Report No. 73. August 1954.

Quantities of Fruits Used by Pie Bakers. Henry T. Badger. Progress report in process.

Quantities of Fruits Used by Preserve Manufacturers. Robert B. Reese. Progress report in process.

FACTORS AFFECTING PRICES OF APPLES -

Progress and Findings - This study examined and evaluated factors and methods whereby the average price received by growers for apples during various parts of the marketing season can be estimated with considerable accuracy early in the season and progressively during the season as revised or new data become available. Price was found to be closely related to production, storage stocks of apples and disposable consumer income. The study was completed in 1954.

Publications

Factors Affecting Prices of Apples. Ben H. Pubols. Agricultural Economic Research. Vol. VI, No. 3, A.M.S., U.S.D.A., July 1954.

RELATIVE PRICES AS THEY AFFECT THE MARKETING OF AGRICULTURAL PRODUCTS - Matching Funds (OES)

Progress and Findings - Attention was focused on the solution of equation models for apples for each of four periods. The objective was to determine the effect of prices of competing products and other factors on the quantities of apples demanded for fresh consumption, storage, export and processing. The apple marketing year was divided into four periods. The first was July and August, the second was September, October, November, and third was December through March, and the final April through June.

The results obtained make it possible to recommend to growers, processors, and storers how much to store, sell, or process in order to get higher returns and also when to move the apple crop and in what form to move it depending upon relative prices of competing fruits and other factors.

Plans - The project will be terminated, but additional computations will be made this fiscal year.

Publications

An Experiment in Designing an Econometric Model to Explain Short Term Fluctuations for Apples. William Cromarty. M.S.Thesis.

A Model to Explain the Short Term Demands for Apples. L. L. Boger and W. A. Cromarty.

Abstract published in the Michigan Quarterly Bul., May 1954.
L. L. Boger and W. A. Cromarty.

B. Proposals for Committee Consideration

MARKETING RESEARCH

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Q. Expand research on new and improved materials for shipping containers and on the development of basic design data and performance standards for containers of various types.	170

B. Proposals for Committee Consideration - Marketing - Cont'd	
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MARKETING SERVICE AND EDUCATION

A. Progress on Work Under Way

a. Service work of USDA

WHOLESALE-RETAILER TRAINING UNDER CONTRACT IN MERCHANDISING OF
FRESH FRUITS AND VEGETABLES - FV

Progress and Findings - 1954 Recommendation, "Expand the work under contract of training wholesalers and retailers in merchandising fresh fruits and vegetables. If possible this work should be expanded to include dried fruits and nuts." (1/14)*

During the past year the program of wholesaler-retailer training in merchandising of fresh fruits and vegetables, conducted under contract by the United Fresh Fruit and Vegetable Association, has been made available in areas of the country not previously reached. In addition, increasing emphasis has been given to the establishment of merchandising departments for wholesalers and the training of merchandising managers and assistants to staff these departments.

Since the inauguration of this program, approximately 35,000 retailers and their employees have received instruction in training classes conducted in 42 States, the District of Columbia, and the Territory of Hawaii. Of these, over 4,000 were trained in the 12-month period ended September 30, 1954. In addition to the retailers trained, a total of 59 merchandising departments have been established for wholesalers with 59 merchandising managers and 513 assistants trained. During the 12 months ended September 30, 1954, a greater volume of this type of work was conducted than during any earlier 12-month period.

Consideration was given to the recommendation for extending the program to include dried fruits and nuts, but it was not considered feasible to include them at this time.

Plans - The present contract with the United Fresh Fruit and Vegetable Association expires in October 1955. In keeping with the committee's 1954 recommendation, it is planned to continue the merchandising training program under contract beyond this date with as much increased emphasis upon the training of wholesalers' merchandising managers and assistants as possible without detracting from the instruction for retailers since it is the foundation upon which the remainder of the program is built.

* 1/14 means first in priority of fourteen recommendations of 1954 in Marketing Service and Education.

MARKET NEWS REPORTING OF TRUCK SHIPMENTS AND TRUCK RECEIPTS - FV

Progress and Findings - 1954 Recommendations - "Expand and improve market news reports by including more information on truck shipments and truck arrivals and extending shipping point coverage." (5/14)

Work to extend motor truck reporting has been under way for several years but limited funds have permitted only a very minor expansion. Truck shipments of fresh fruits and vegetables now are being reported on a daily basis in Arizona, California, Florida, the lower Rio Grande Valley of Texas, and seasonally in a few other localized shipping areas. During the past year, weekly reports were inaugurated on truck shipments of Oregon and Washington apples and pears. Truck arrival reports were started during the past year in Cincinnati, bringing to 19 the number of major terminal markets in which truck receipts are reported.

Plans - Reporting of truck receipts and truck shipments on an origination point basis will be extended to additional market and major shipping areas as rapidly as funds will permit.

- A. Proposal for Committee Consideration - Expand market news reports to include more information on truck receipts and truck shipments. It is proposed that the reporting of truck receipts by commodities and States of origin be extended to a total of 75 major terminal markets as rapidly as possible, and that the reporting of truck shipments be extended to additional major deciduous fruit shipping areas where practicable. While such extended reporting will not give as complete a picture of truck movement of fresh fruits and vegetables as is now available on rail shipments and rail unloads, it is believed that it will provide sufficient coverage to indicate accurately the day-to-day and week-to-week trends in the total volume moving by truck.

IMPROVE SAMPLING METHODS USED IN INSPECTIONS OF FRESH AND PROCESSED FRUITS AND VEGETABLES - FV

Progress and Findings - 1954 Recommendations, "Initiate a study of sampling methods used in the inspection of fresh and processed fruits and vegetables to devise improved sampling procedures where practicable." (7/25)

A modest beginning of work on this problem has been made during the past year. Some basic data have been collected on the variation in quality that exists in individual lots of certain fresh and processed fruits and vegetables and this work is continuing. In addition, analyses have been initiated of the conditions under which inspections must be conducted.

Plans - During the initial phase of the study the statisticians assigned to this work are acquiring background information on the whole range of fruits and vegetables, becoming thoroughly familiar with all aspects of inspection procedures and with the various methods followed in handling, packing, and processing. The next step will be intensive studies confined to one commodity or a small group of related commodities at a time since there are wide differences between the methods followed in packing and handling different fruits and vegetables and between different plants handling the same commodity.

- B. Proposal for Committee Consideration - Expand the study of sampling methods used in the inspection of fresh and processed fruits and vegetables to devise improved sampling procedures where practicable. This represents a major and continuing problem in the inspection of fruits and vegetables. Not only does it involve the adequacy of the size of sample and its design and selection. Also concerned are questions of measuring specific grade factors, the application of limiting rules in the standards, the use of statistical quality control techniques in plants under continuous inspection, and the revision of grade standards in the light of modified inspection procedures. Since the approach to improve sampling and inspection procedures must be largely on a commodity-by-commodity basis, it is highly desirable that a greater amount of effort be devoted to this problem than is possible at the present time.

ANNUAL ESTIMATES OF FRUIT AND NUT TREES - AES

Progress and Findings - 1954 Recommendation "Expand the project on estimating annually the number of bearing trees and bearing acreages of the important fruit and nut crops by States." (9/14)

The work on this project was limited to a few States in which State Departments of Agriculture sponsored the projects. Lack of funds is the factor limiting the work on this project on a national scale.

The Pennsylvania State Department of Agriculture published the results of their 1953 fruit survey which was financed entirely with State funds. The Agricultural Statistician cooperated on this project. Tree surveys, financed by AMA funds allotted by Agricultural Marketing Service and matched by State funds, were made or are being made in West Virginia, Illinois, North Carolina, Michigan and Kentucky. The California Crop Reporting Service, in cooperation with the State Department of Agriculture, made the usual annual county fruit and nut reports for that State. This work was financed by AMA funds allotted by Agricultural Marketing Service and matched with State funds. The Agricultural

Statistician in Idaho cooperated with the Idaho Department of Agriculture in making a tree survey for that State. The Wisconsin State Department of Agriculture published the results of their 1953 cranberry survey. This work was done under the guidance of the Agricultural Statistician and was financed by AMA funds allotted by AMS and matched with State funds.

Plans - This project should be enlarged to cover all States and all fruit and nut crops. The work is again being recommended for committee consideration.

- C. Proposal for Committee Consideration - Initiate a national program of estimating annually the number of bearing trees or bearing acreage of important fruit and nut crops by States.

At present, the only continuing annual information available on the number of bearing trees or bearing acreages is for California. In a few other States, occasional special surveys covering tree numbers or bearing acreage of fruit are made. The work is limited and now depends mostly upon the availability of AMA funds for allotment to the States and the availability of State funds, and the allocation of these matched funds for this type of work. In order to have a uniform program for all areas and to keep the data on a current basis, the work should be a part of the annual estimates made by Agricultural Estimates. The program would provide for complete coverage of orchards, groves and vineyards in each State once every five years. This would require a complete enumeration of a group of 8 to 10 States each year. In the intervening years year-to-year changes would be obtained by sample surveys.

The industry, in planning their present marketing operations and future potential possibilities, need information on number of trees or acreage, age of trees and varieties of trees. The Department of Agriculture needs to know the current numbers and ages of trees as a basis for improving the estimates of production.

Publications

Pennsylvania Fruit Tree Survey 1953

West Virginia - Commercial Apple and Peach Tree Survey 1953

Illinois - Apple and Peaches 1953

California - Fruit and Nut Crops as of 1953

Idaho - Commercial Fruit Tree Census 1954

Wisconsin - Cranberries in Wisconsin

PRODUCTION ESTIMATES OF SMALL FRUITS - AES

Progress and Findings - 1954 Recommendation "Initiate a program to estimate production of small fruits, other than cranberries and strawberries." (10/14)

Except for the report in California on acreage of bush berries, no work was undertaken because of the lack of funds. The report for California was financed by Agricultural Marketing Act funds allotted by Agricultural Marketing Service and matched with State funds.

- D. Proposal for Committee Consideration - Initiate a program to estimate production of small fruits, other than cranberries and strawberries. The Department receives many requests for statistics on blueberries, raspberries, blackberries, boysenberries, Youngberries and loganberries. At the present time we do not have a program for these small fruits, similar to the information on fruit and nut crops.

The inauguration of a program of estimates on small fruit would consist of early season estimates of acreage and forecasts of production; and end-of-season estimates of acreage harvested, yield per acre, total production, prices received by growers, value of production, and value of sales by States. Special surveys would be required to establish benchmark data and annual sample surveys of acreage, yield and price would be required thereafter to maintain the program.

Publication

California Bush Berries

DEVELOPMENT OF NEW AND REVISED STANDARDS FOR GRADES OF PROCESSED FRUITS AND VEGETABLES - FV

Progress and Findings - 1954 Recommendation, "Expand work on development and revision of U. S. Standards for grades of processed fruits and fruit products and the development of objective methods for measuring quality characteristics." (11/25)

A moderate expansion was made in 1955.

During the past year the grade standards for canned apples and frozen apples were revised. Proposed revisions have been published for comments and discussion for dried apples and frozen strawberries. New standards have been proposed for dehydrated apples and frozen concentrated grape juice. In addition, data have been developed for use in revising the standards for canned freestone peaches, canned clingstone peaches and canned apricots.

Methods for determining the drained weight of frozen and red sour pitted cherries in 30-pound containers were tested and an official method selected and issued.

In order to provide more uniform interpretation of the quality requirements in the standards, the development of visual aids such as photographs, drawings, models, and other devices for illustrating objectively certain quality characteristics, continued to be emphasized during the year. One hundred forty wax models showing color classes of sulphur-bleached and golden-bleached raisins have also been made and distributed. Additional models showing trimming of canned pears and minimum color of frozen red sour pitted cherries have been made and distributed. Painted wax models showing growth cracks and broken skins of dried prunes have been developed. Colored wax models illustrating color classifications of whole and sliced strawberries are nearly completed. Color sketches showing styles of dehydrated apples and defects on canned apricots have been prepared.

Plans - It is planned to complete the revision of the standards for dried apples and frozen strawberries and issue the new standards for frozen concentrated grape juice and dehydrated apples. Revisions of the standards for canned apricots, canned freestone peaches, and canned clingstone peaches are planned to follow these. If time is available, revisions of the grade standards for apple butter, dried prunes, dried raisins, dehydrated prunes and canned sweet cherries will be developed.

It is planned to complete the wax models to illustrate color classifications for frozen strawberries and to develop visual aids for color classification of apple butter and color comparators for kinds of fruit preserves.

- E. Proposal for Committee Consideration - Expand work on development and revision of grade standards for processed fruits and fruit products, including more extensive testing and evaluation of objective methods which have been developed for measuring quality characteristics. The most urgent need now appears to be the development of grade standards for certain fruit concentrates, such as apple juice and pineapple juice, and for fruit nectars, pureed fruits and fruit beverages. Consideration should be given to providing grade requirements for dietetic packs. The nature of the sweeteners used, drained weight requirements, and quality characteristics of the fruit are such that separate and distinct standards for the products may be desirable.

Also urgent is the need for an increased amount of work on the testing and evaluation of objective methods for determining quality in order to determine their suitability for incorporation in grade standards and official inspection procedures, and to arrive at approximate quality cut-off points in line with good commercial practice. Consistency devices, methods for rapidly determining moisture content, and devices for determining maturity and texture of products are available and should be tested and evaluated.

Publications

New and revised standards are published in the Federal Register when promulgated and duplicate copies are available to interested parties.

BASIC STATISTICS ON PRODUCTION, UTILIZATION AND PRICES - AES

Progress and Findings - The Crop Reporting Board of the Agricultural Marketing Service is responsible for the statistical reports on production, utilization, price and value of agricultural products. The program covers 17 kinds of deciduous and miscellaneous fruits and 5 kinds of nuts. The schedule of reports is listed under publications.

The study on estimating grape production in California on the basis of a mail survey of production in individual vineyards was continued. The survey is used to supplement the indications of production based on the reported condition. Work on estimating the production of filberts in Oregon by objective methods was started in late 1954. These projects were financed by Agricultural Marketing Act funds allotted by AMS and matched with State funds. The work on objective methods of estimating peaches and pears was continued in California. This project is in cooperation with the Giannini Foundation and financed by industry groups for the respective fruits and Agricultural Marketing Act funds allotted by AMS and matched with State funds.

Plans - The plans for 1955-56 for the regular work are to carry on the present program to the extent that available funds will permit and to use AMA funds allotted by AMS and matched with State funds where such funds are available.

Publications:

See following table.

C - Condition

F - Forecast of Production

FRUITS AND TREE NUTS: CALENDAR OF RELEASES

Prod. - Estimated Production
Rev. - Revised Estimate

Sp. - Special

	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	May	June	July	Aug.
FRUITS 27 37	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/	1/
Apples 1	-	-	-	F	F	F	F	F	Prod. 5/	1/	1/	1/	1/	3/174/5/
Peaches-10 Southern States	C	F	F	F	F	Prod. 6/	6/	-	Prod.	Prod.	-	Rev.	-	-
California	-	C	F	F	F	F	Prod.	-	Prod.	Prod.	-	Rev.	-	-
Other States	-	-	F	F	F	F	Prod.	-	Prod.	Prod.	-	Rev.	-	-
Pears - California	-	C	F	F	F	F	F	Prod.	Prod.	Prod.	-	Rev.	-	-
Other States	-	-	F	F	F	F	F	Prod.	Prod.	Prod.	-	Rev.	-	-
Grapes -California	-	C	C	F	F	F	F	Prod.	Prod.	Prod.	-	Rev.	-	Rev.
Other States	-	-	-	F	F	F	F	Prod.	Prod.	Prod.	-	Rev.	-	Rev.
Sour Cherries (11 States)	-	C(Wash:F(6W	F	F	Prod.	-	-	-	Prod.	Prod.	-	Rev.	-	-
	-	(Ore.:F(5E(Sp.):	-	-	-	-	-	-	-	-	-	-	-	-
	-	:6/15	-	-	-	-	-	-	-	-	-	-	-	-
Sweet Cherries-California	-	F	F	Prod. 6/	-	-	-	-	Prod.	-	Rev.	-	-	-
Other States(10)	-	C(Wash:	F	F	Prod.	-	-	-	Prod.	-	-	Rev.	-	-
	-	(Ore.:	-	-	-	-	-	-	-	-	-	-	-	-
Plums-California	-	F	F	F	F	Prod. 6/	6/	-	Prod.	-	Rev.	-	-	-
Michigan	-	-	C	F	F	F	Prod.	-	Prod.	-	-	-	Rev.	-
Prunes-California	-	C	F	F	F	F	F	-	Prod.	-	-	Rev.	-	-
Wash., Oregon & Idaho	-	-	C	F	F	F	Prod. &	-	Prod. &	-	-	-	Rev.	-
	-	-	-	-	-	-	utiliz.	-	utiliz.	-	-	-	-	-
Apricots-California	-	F	F	F	F	F	Prod.	-	Prod.	-	Rev.	-	-	-
Wash. & Utah	-	-	F	F	F	F	Prod.	-	Prod.	-	-	Rev.	-	-
Cranberries-(5 States)	-	-	-	-	F(Sp)8/15F	F	Prod.	-	Prod.	-	-	-	Rev.	-
Figs-dried (California)	-	-	C	C	C	C	C	-	Prod.	-	-	-	Rev.	-
not dried (California)	-	-	-	-	-	-	-	-	Prod.	-	-	-	Rev.	-
Olives (California)	-	-	C	C	C	C	C	C	Prod.	-	-	-	Rev.	-
Avocados-Florida	-	C	C	C	C	C	C	C	Prod.	-	-	-	Rev.	-
California	-	C	C	C	C	C	C	C	Prod.	-	-	-	Rev.	-
Dates-California	-	-	-	-	-	-	-	-	Prod.	-	-	-	Rev.	-
Pineapples-Florida	-	-	-	-	-	-	-	-	Prod.	-	-	-	Rev.	-
Pomegranates-California	-	-	-	-	-	-	-	-	Prod.	-	-	-	Rev.	-
Persimmons-California	-	-	-	-	-	-	-	-	-	-	-	-	Prod.	-

	:Apr.:	May	:June	:July	:Aug.	:Sep.	:Oct.	:Nov.	:Dec.	:Jan.	:May	:June	:July	:Aug.
NUTS 2/ 4/	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Walnuts-California	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Oregon	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Filberts-(2 States)	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Pecans-(10 States)	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Almonds-(California)	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Tung Nuts-(5 States)	:	:	:	:	:	:	:	:	:	:	:	:	:	:

1/ Monthly Crop Report

2/ "Production and Value, Principal Fruits and Tree Nuts" for previous two years is published about the middle of January.

3/ "Fruits (Non-Citrus): Production, Farm Disposition, Value, and Utilization of Sales" for previous two years is published the first part of July.

4/ "Tree Nuts: Production, Farm Disposition, Value, and Utilization of Sales" for previous two years is published in August.

5/ Apple variety estimates are published in December and revised following July.

6/ Last forecast or estimate carried forward unless significant change indicated by new evidence.

- F. Proposal for Committee Consideration - Resume the August forecast of the production of apples by varieties. At the present time variety estimates are not prepared for the major producing States and areas until December. In the marketing of apples, information is needed during the growing season on the prospective production of important varieties of summer, fall and winter apples by areas. The program would require a special survey to growers about August 1 on the prospective production by varieties.

PLANNING MARKETING FACILITIES IN SPECIFIC LOCALITIES - MRD

Progress and Findings - During the past year 34 localities were assisted in planning and constructing improved marketing facilities. In addition, information was furnished a large number of individuals who were interested in building wholesale stores, warehouses, and other kinds of individual facilities for the handling of farm and food products.

Wholesale produce markets for which studies were made by USDA, were completed or were in various stages of construction in 9 places: Boston; Savannah; Jacksonville, Tex.; Houston; Indianapolis; Louisville; Nashville; Rochester; and San Juan. In 5 of these the new markets are operating.

During the year reports were published setting forth the results of studies to develop plans for wholesale produce markets in Birmingham and San Diego. Supplements to previous reports on wholesale markets in Baton Rouge and Waco were also prepared.

A number of new studies were started during the year. The largest of these was a study in Philadelphia to develop plans for a complete wholesale food center to serve the city and surrounding trade territory. This center will occupy some 420 acres. The plan includes facilities for wholesalers of fruits, vegetables, meats, poultry, eggs, butter, cheese, fish, frozen foods, dry groceries, and allied industries. In several localities in which market facility studies were made in previous years follow-up work has been necessary in giving assistance in the choosing of sites, the development of layouts, determining possible methods of financing, and planning for market management and operation. In several cases, upon request, State and local groups have been given assistance in preparing legislation dealing with market facilities.

Throughout the year the Branch continued to receive many more requests for assistance in planning market facilities than it could meet. While an effort has been made to confine the work to those places where the need is greatest and where the interest indicated that action would be taken, still it is impossible to comply with all the worthwhile requests that were received.

Plans - This work will be continued. As studies are completed in one locality, personnel and resources will be shifted to other localities where specific requests have been made for assistance.

Publications

The Wholesale Produce Market at Birmingham, Ala. S. D. Clark. Jan. 1954.

Wholesale Produce Markets of San Diego, Calif. T. D. Johnson. May 1954.

DECIDUOUS FRUITS AND TREE NUTS SITUATION AND OUTLOOK

Progress and Findings - The situation and outlook pertaining to demand, price, supplies, distribution, consumption and related aspects of fresh and processed deciduous fruits and tree nuts are continuously being examined. Results are summarized and published monthly, quarterly, and at other intervals of time, so as to provide timely, helpful information to producers, marketing agencies, and others.

Plans - It is planned to continue this work on its present basis.

Publications

1. "Fruit Situation". Published January, June, August, and October. The issue for October is a comprehensive Outlook report.
2. "Demand and Price Situation". Published monthly, and includes a summary of the price situation for deciduous fruits and tree nuts.
3. "National Food Situation". Published quarterly, and includes a summary of supply and consumption aspects for deciduous fruits and tree nuts.

FOREIGN COMPETITION, PRODUCTION AND CONSUMPTION OF DECIDUOUS FRUITS
AND TREE NUTS - FAS

Progress and Findings - 1954 Recommendation, "Expand survey of West European fruit production with the major emphasis on the longer competitive aspects. Initiate another survey of the foreign tree nut situation. Both of these recommendations will be effectuated as pointed out under Plans.

The fruit marketing specialist stationed in Europe has transferred his post from Paris to London and continued his activity in promoting markets for United States fruits and fruit products. Special attention has been directed towards negotiating with the Government authorities in London to enable some resumption of the exports of fruits and fruit products from the United States to the United Kingdom.

The citrus marketing specialist has made two trips during 1954, each involving a visit to the Mediterranean producing areas and to the European market areas for the purpose of appraising and reporting on competitive supplies of citrus fruits in the Mediterranean producing areas and the market prospects for European citrus fruit in the European market area. The first of these trips was made immediately following the freeze in Spain which occurred in the early part of February 1954 and a report summarizing the magnitude of the frost damage was made. The second was made in the fall of the year for the purpose of forecasting the 1954-55 Mediterranean citrus crop and appraising market conditions and prospects.

The processed fruit marketing specialist visited the market areas in Western Europe and the Scandinavian countries for the purpose of appraising market conditions and prepared a report summarizing market potentials in these countries for dried fruits.

A survey of the foreign dried fruit and tree nut situation in the Mediterranean area was initiated and is being undertaken at the present time.

Plans - (1) Steps are underway to employ a consultant to undertake a survey of the reported increase in production in deciduous fruits in Western European countries and to analyze its effect upon potential markets for United States deciduous fruits in Europe;

(2) It is planned that a foreign marketing specialist will visit the principal market centers in South American countries to appraise and initiate steps, if possible, leading towards development of additional exports of United States fruits and fruit products to South American countries.

Circulars - Circulars issued during 1954 were as follows:

Apples/Pears

"Southern hemisphere deciduous fruit notes"	3/30/54
"1953 Italian Exports of Apples, Pears, and Peaches Increase"	4/7/54
"1954 Apple and Pear Crop Estimates in North America and Europe"	9/23/54

Dried Fruit

"World 1953 Raisin Pack Estimate Down"	3/15/54
"French Dried Prune Production and Trade"	3/24/54
"Chilean Dried Prune and Fresh Plum Situation"	5/5/54
"1953 Foreign Fig Crop Largest Since 1950"	5/28/54

Nuts

"World 1953 Filbert Production Estimate Revised Downward"	2/1/54
"India Cashew Crop 1954 Forecast Above Last Year"	2/23/54
"Foreign Almond Production for 1953"	4/26/54
"Observations on Almond and Filbert Industry in Spain After Freeze of February, 1954"	5/10/54
"Observations on the Almond and Filbert Industry in Spain after the Freeze of February 1954" (Burke & Stugard)	5/10/54
"Prospective 1954 Brazil Nut Harvest and Marketing Situation in Amazon Valley"	5/19/54
"Large Iranian Almond Crop Forecast"	6/16/54
"1954 India Cashew Crop Forecast Same as Last Year"	6/22/54
"Foreign Almond Production Forecast Lowest Since 1951"	7/8/54
"Filbert Production in 1954 Forecast Highest since 1951"	7/22/54

Soft Fruit

"Chilean Dried Prune and Fresh Plum Situation"	5/5/54
"World Production of Stone Fruits"	5/21/54

MARKETING SERVICE AND EDUCATION (cont)

b. Service Work by State Departments of Agriculture or Bureau of Markets

A. Progress on Work Under Way

During the past year 16 State Departments of Agriculture carried on marketing service activities pertaining to deciduous fruits and tree nuts. The work centered around quality improvement and maintenance, expanding market outlets and the collection and dissemination of basic data and local and nearby market information.

IMPROVING PRODUCT QUALITY THROUGH BETTER GRADING, HANDLING AND PACKING

Progress and Findings - 1954 Recommendation, "Expand the cooperative work with State departments of agriculture on promoting the adoption of better methods of grading, packaging, cooling before shipment, handling, loading for shipment, and storage."

Additional funds in 1954-55 provided for some increase in these activities.

Packing, grading and handling assistance and demonstrations were provided for peaches or apples in Maryland, Indiana, South Carolina, Maine, North Carolina, Virginia, Mississippi, and Michigan; for red sour cherries in Michigan, and; for pecans in Mississippi. In Indiana and Maryland demonstrations of grading and packing tree ripened peaches encouraged a number of large producers to allow their peaches to ripen prior to picking. This program proved to be quite successful and was well received. Indiana growers, for instance, realized increased production of about 17 percent - mostly of top grade fruit. North Carolina apple producers were assisted in organizing and developing operating procedures for a grading, packing and selling cooperative. It is expected that close to 75,000 bushels of apples harvested in the fall of 1954 will be sold by the cooperative. A movie entitled, "Picking Peaches for the Consumer," made jointly by the Extension Service and State Department of Agriculture, was completed in February 1954 in South Carolina for showings at grower meetings and on the farm (In South Carolina service activities are carried on by Clemson College). State agencies in other States have purchased copies of the film for similar work. In addition, nine grower meetings were held in South Carolina at which proper methods of grading, packing and cooling peaches were discussed. And extensive use was made of radio and newspapers to publicize the advantages of the use of proper techniques and how to apply them. A State label program was initiated in Virginia under which 1,000 bushels of apples were packed and promoted in Norfolk on a trial basis. Apples packed under the label, which carries the words, "A Product of Virginia Traditional Quality; State Inspected and Approved" brought top market prices.

Grading and packing demonstrations and assistance were provided for strawberries, blueberries and other small fruits in Kentucky, and Maryland. Also, in Kentucky, printed schedules were provided pickers and graders for their guidance during the season.

Work on grading and handling included assistance in developing better methods as well as assistance and demonstration in applying existing approved techniques. In Illinois, tests have been made comparing space utilization and the incidence of bruising and other damage using the conventional system of loading bushel baskets of peaches and the inverted system with the results favoring inversion. Work was continued in California in the development of more dependable methods of determining minimum maturity for apples and freestone peaches. Such methods will be used by industry in picking operations and by enforcement agencies in grades and standards work. For wine grapes, comparative tests of soluble solids content were made using the standard hydrometer, presently the customary method, and the faster sugar scale hand refractometer. The amount and depth of bruising in picking and delivering Gravenstein apples to the packing shed and in washing, sizing, packing and lidding was analyzed and conclusions released to the industry. Similar work at shipping point was done in Maine supplemented by comparisons of bruising in various types of packages in trade channels, including retail stores. In South Carolina a survey is underway to ascertain the effectiveness of hydrocooling peaches. Assistance was provided New York apple growers in developing proposals for regulations designed to eliminate the present practice of placing undersized fruit in count packs, such as carton cell and molded tray packs. At the request of the apple industry, the Michigan Department sponsored a tour by several growers and Department marketing specialists of modified air storages in New York State. There, experiments are being carried on with respect to methods of lengthening the shelf life of apples after leaving storage. North Carolina peach producers received assistance in the installation of pre-cooling facilities, and in obtaining custom cooling service. This resulted in the addition of 5 pre-cooling units during the year which, together with the 3 existing units, handled approximately 87,000 bushels. It is estimated that pre-cooled peaches brought a premium of \$.70 per bushel. In Washington the pilot quality improvement and market expansion project for strawberries and canberries was continued into 1954. Through the use of better packs and packaging techniques and gas to decrease the incidence of mold, shipments were extended to Montana, Colorado and other nearby States and the city of Chicago without significant waste or spoilage. Also, new types of blackberry pie filling were developed in cooperation with research agencies, and placed on the market. At the present time, tests of consumer acceptance are being conducted in retail stores. Maryland peach producers were assisted in testing the consumer acceptance of peaches packed in various types and sizes of containers.

To improve the acceptance and marketability of nursery stock, the development of techniques and procedures for certifying that such stocks are disease free was continued in California, Minnesota and Michigan. Commodities covered in this work were cherries, peaches, strawberries, nectarines, almonds, plums, prunes, apricots and grapes. The greatest progress to date in methodology development has been with cherries. Nurserymen able to certify to virus free stock are obtaining premium prices.

- A. Proposal for Committee Consideration - Expand programs to improve and maintain quality of deciduous fruits, small fruits, and tree nuts through the development and adoption of better harvesting, grading, packing and handling methods.

Publications

"Producers Guide for Marketing Strawberries"; Kentucky Department of Agriculture.

"Picking Peaches for the Consumer" (a colored, narrated, 16 m.m. movie); South Carolina State Agricultural Marketing Commission, completed, February, 1954.

EXPANDING MARKET OUTLETS

Assistance was provided in improving and widening the distribution of deciduous fruits and tree nuts in Oklahoma, Maryland, Maine, Indiana, Illinois, Kentucky, Michigan, North Carolina, Virginia and California. The Indiana "Produce Supply Report" was continued covering location, anticipated supplies and harvest dates of locally produced deciduous fruits and berries. This report was mailed weekly to about 700 persons and firms, including shippers, brokers, truckers and other potential buyers. The purpose of the program is to expedite the movement of the commodities into trade channels with minimum loss and spoilage and at maximum returns to producers. The North Carolina, Maryland, Oklahoma and Michigan Departments issue similar produce reports. In Illinois, the information program has been as effective in moving offgrade or storm damaged fruit as the better quality lots. For instance, large quantities of low grade apples were marketed at profitable prices because truckers knew the "where, when and how much" of the situation. Also, in Illinois an annual brochure entitled, "Your Guide to Illinois Fruits" showing production areas and names, addresses and phone numbers of producers was issued just ahead of the harvest season. In recent

years strawberry production in Kentucky has expanded rapidly. For the benefit of out-of-State buyers, a publication entitled, "1954 Kentucky Strawberry Buyers' Guide" containing data about new areas, production estimates, varieties, market facilities, harvest dates and other information was prepared and mailed to 1,100 concerns. Current information was also provided during the season on volume of marketings by area.

Promotional assistance in developing wider distribution of deciduous fruits was provided in North Carolina, Illinois, Indiana, Virginia and Maryland. Radio and television were employed in promoting the sale of North Carolina peaches. In Indiana a weekly report promoting products in plentiful supply was released to consumers through 35 newspapers, and 97 radio stations. The Indiana State Fair Peach Promotion campaign was carried on for the second year to promote the sale of tree ripened peaches through on-the-spot demonstrations as to appearance and taste. Tape recordings were taken of consumer interviews at the Fair and of later retailer interviews. These recordings will be used at future grower and shipper meetings. In cooperation with the Virginia Apple Commission, Department specialists planned and operated an apple promotion program in Richmond and Norfolk. The program included advertising, exhibits, contacts with food editors, appearances on radio and television programs and dealer service work with retailers.

- B. Proposal for Committee Consideration - Expand programs of widening marketing outlets and moving seasonal surpluses by providing buyers and other marketing agents with complete information on available supplies, and by providing promotional assistance.

Publications

"1954 Kentucky Strawberry Buyers' Guide"; Kentucky Department of Agriculture.

"Your Guide to Illinois Fruits"; Illinois Fruit Council.

COLLECTION AND DISSEMINATION OF MARKET NEWS AND BASIC DATA

Progress and Findings - 1954 Recommendation, "Expand the cooperative work with State departments of agriculture on basic market information."

Additional funds in 1954-55 provided for some increase in these activities.

Producers and processors have requested data on basic production and consumption trends in order to develop effective long term marketing programs. Important types of information required are trends in tree numbers, acreage, production, changes in consumer demand, the competitive situation in markets, quantities in storage and the rate of disappearance, and price and cost data for the various kinds of products. Basic data of this general type were collected, analyzed and reported to producers, dealers and other interested groups in Illinois, California, New York, Wisconsin and Michigan.

A peach tree count conducted in Michigan revealed that the number of bearing trees dropped 10 percent per year the past 2 years. Cherry trees were also counted in Michigan. In Illinois, county data were assembled and disseminated on number of apple and peach trees by variety and age, and on production. There the tree population is only one-fifth of that existing in 1924. Information on total apple and grape acreage and trends in new plantings by varieties on a county basis was collected and summarized in New York. These data were used by the Extension Service and other agencies in discussing the selection of varieties to plant in light of likely future production of the different types of fruit as indicated by plantings and removals. Data on trends in acreage, production, utilization, plantings and removals were assembled on all California deciduous fruits, tree nuts and bush berries.

At the request of marketing order advisory boards, the California Department of Agriculture has tested the feasibility of using objective sampling methods to forecast more accurately the production of Bartlett pears and cling peaches. These tests appear promising and are yielding a considerable amount of valuable related data as a by product. For instance, the information gathered in the course of the tests indicate growth rate of fruit, advance information on the degree of injury from insects, disease and weather and early indications of sizes and grades at maturity. In Michigan work has been conducted on the development of more dependable methods for forecasting sour cherry production. Yield per tree and likely production can be estimated with increased accuracy using the tree count referred to above, growers' reported percent of full crop and an index of crop advancement based on daily maximum temperatures. Data on Wisconsin cranberry production and marketing methods were assembled and published last year in a bulletin entitled, "Wisconsin Cranberries; Production, Varieties and Utilization." This publication includes current and historical information and projections of supply by varieties based on rate of plantings, and age and production of existing plantings.

Market information releases were issued periodically in Kentucky, New York and Michigan. These releases included up-to-date summaries of prices, marketings, quantity and location of available supplies. In addition, the Michigan strawberry releases included reports on conditions in States whose production is marketed just prior to or simultaneously with that of Michigan. In New York the report also includes prices f.o.b. country storage, and the movement of apples to the retail store, in and out of storage and storage holdings.

- C. Proposal for Committee Consideration - Expand programs for collecting and disseminating basic market information.

Publications

Bulletin 54-3, Illinois State Department of Agriculture, 1954. (contains current and historical data by counties on apple and peach varieties, age, number of trees and production)

Current published summaries of (1) bearing and non-bearing acreage of tree fruits and nuts and vines by varieties, and age groups on a county basis and (2) production, utilization, and price of various kinds of bushberries; California State Department of Agriculture, 1954.

"Wisconsin Cranberries: Production, Varieties, Utilizations, Markets," Bulletin No. 322, Wisconsin State Department of Agriculture, November - December, 1953

"Marketing Activities"; Market Expansion Section, Virginia Department of Agriculture, July, 1954.

"Apple Marketing Almanac - Maryland and the Appalachian States" - Maryland State Department of Agriculture.

IMPROVING MARKET FACILITIES AND EQUIPMENT

Progress and Findings - 1954 Recommendation, Expand the cooperative work with State departments of agriculture on improving market facilities, equipment, and procedures.

Additional funds in 1954-55 provided for some increase in these activities.

Technical assistance was provided in improving existing marketing and processing facilities and equipment and in designing and locating new facilities in South Carolina, Virginia and Tennessee and promotional assistance in achieving more efficient use of existing facilities was provided in Mississippi. In Virginia, a market site study requested by the Fredericksburg City Council recommended the construction of a new wholesale and farmers' market with 3 wholesale store units and 25 farmer sheds. Assistance was also provided the Richmond Market Authority and the Norfolk Port Authority in planning new markets in general accordance with recommendations of studies made by the U. S. Department of Agriculture. Technical assistance in planning and locating processing plants was provided in Tennessee. Growers are being encouraged to help in establishing local plants by assuring processors of enough volume to permit efficient operations.

Fuller utilization was made of the Farmers' Central Market in Jackson, Mississippi through a special program to acquaint producers with the facilities available in the market sponsored by the State Department of Agriculture, the Extension Service and the Farmers' Market Central Board. More than twice as much produce moved through the market than in any previous year.

- D. Proposal for Committee Consideration - Expand service work in improving existing facilities and designing, and locating new facilities such as country assembly markets and processing plants, and advising marketing agencies with respect to the kinds of handling equipment and methods best suited to their operations.

MARKETING SERVICE AND EDUCATION (cont.)

A. Progress on Work Under Way

c. Educational work of Federal Extension Service

Educational programs on the marketing of deciduous fruit and tree nuts are conducted by the Cooperative Extension Services in most important producing States. Consumer information projects aimed at encouraging consumption of products in heavy supply are in operation in most of the heavily populated States. Educational programs with retailers, having as their objective reduction of waste and better merchandising of foods, are being conducted in about two-fifths of the States.

Commodity marketing projects were in operation in practically all important States where fruits and vegetables and tree nuts are grown in 1953-54. These educational projects in the marketing of fruits and vegetables are conducted by State extension marketing personnel. Many of them were on regular extension funds and long before the passage of the Research and Marketing Act of 1946. In addition to these regular fund marketing programs, county agricultural agents work on many local problems which do not involve college staff personnel.

For the sake of simplicity, fruit marketing work has been broken into the following general areas:

Educational Work at Country Point With Farmers and Marketing Agencies on Improved Marketing Practices, Methods, and Organization

Progress and Findings - 1954 Recommendation, "Expand extension work at country point with producers and marketing agencies on marketing practices, methods, and market organization.

Additional funds were provided for the expansion of this work in fiscal year 1955.

During the past year there were some 18 AMA projects dealing with deciduous fruits and tree nuts in 16 States. Generally, there are one to two full-time specialists employed on each of these projects. Educational work with growers and others at country point involves at least two types of work: (1) The solution of specific problems, and (2) general outlook and informational work. Work on specific problems involves such activities as the development of marketing organizations, analysis of marketing structure for fruits and tree nuts, and educational programs on the grading, packaging, grower-processor relationships, market outlets, etc. The outlook work on market prospects for various fruits and nuts is also an important phase of extension marketing programs with this group of people.

Examples of the type of educational work conducted by the Extension Service with growers, processors, and other handlers follow:

In North Carolina, South Carolina, and Georgia, the extension marketing specialists carried on educational work with producers, shippers, and marketing agencies and firms pointing out the advantages of precooling of peaches.

During the past several years much research and experimentation have been conducted on the prompt removal of field heat from peaches by precooling. Likewise, research has revealed that the American consumer prefers a more mature peach and is apparently willing to pay for it. However, growers and representatives of marketing agencies realized that to give the consumer a high quality fruit with a more advanced state of maturity they must remove the field heat as soon as possible after picking. It has been revealed by research that if field heat is removed from the fruit within a few hours after picking to as low as 45° Fahrenheit the ripening process is retarded for three or four extra days, permitting peaches to be marketed at a more advanced stage of maturity. Furthermore, it has been estimated that peach losses occurring in the marketing system amount to almost 6 million dollars annually and most of these losses are caused by brown rot and rhizopus rot. It has been discovered by research studies that the rapid removal of field heat controls and retards these two types of rot and that, therefore, substantial savings can be effected from the prompt removal of field heat from peaches.

In 1952 there were only two hydrocoolers used for precooling peaches in South Carolina. As a result of an intensive educational program with the peach growers, shippers, and marketers during the peach marketing season and in the winter of 1953 some 24 hydrocoolers were in operation in South Carolina in 1954. It is estimated that between 3,000 and 3,500 cars of the 4,700 cars shipped out of South Carolina in 1954 were precooled. Similarly, educational programs were carried out with peach growers, shippers, and marketers in Georgia and North Carolina pointing out the advantages of rapidly removing field heat from the fruit. As a result of these programs, it is estimated that over 75 percent of the peaches shipped from the Fort Valley area of Georgia alone in 1954 were precooled.

It is only through an intensive, effective educational program that the time lag between the results of research and its application can be reduced to a minimum. Educational programs such as these will be carried out with growers and shippers and others in Maryland, Pennsylvania, Michigan and in other important peach producing States during the coming year.

The educational work with roadside stands operators increased in 1953-54. Perhaps as a result of the continued decline in farm prices during the past year, more requests have come from growers to assist them in roadside marketing of their products. These educational programs have assisted growers with a more effective selling program in improving their roadside stand facilities and merchandising programs. In Massachusetts, over 100 roadside stand operators attended a series of meetings held by the extension marketing specialist. Visits to these and other operators by the specialist and county agents have indicated cleaning up of the grounds, continued improvements of signs, new stands being built, etc. In California, a merchandising organization has been considered as a possibility of improving the merchandising programs of roadside stand operators.

A number of States, including Maryland, New Jersey, Michigan, New York, Florida, only to mention a few, have been assisted in one way or another with the development of plans for precooling strawberries and other fruits and vegetables. In Arkansas, a large proportion of the extension marketing specialist's time was devoted to meetings held in a large number of the counties relative to the marketing of fruit and vegetable crops to processors. Grading demonstrations were conducted in a number of the States last year. In Kentucky and Arkansas, commercial interests were assisted and advised in the establishment of freezing plants in areas where none existed. Practically all extension marketing specialists devote some time to outlook for various fruits, including an analysis of the competitive position of specific fruits in the market place, trends in consumption, and the supply available from various producing areas. An example of this type of work includes North Carolina and Mississippi where a number of buyers in northern consuming centers are supplied at their request with information about expected supplies and shipping dates for certain fruits.

Plans - With funds presently available, work during the coming year will continue with some additional emphasis.

- A. Proposal for Committee Consideration - Expand and intensify educational work with growers, marketing firms, and allied industry people to improve product quality through better grading, packing, containers, and other marketing methods, practices, and procedures.

Educational Work With Wholesalers, Retailers, and
Secondary Suppliers to Encourage Better Handling
and Merchandising Methods and Practices.

Progress and Findings - 1954 Recommendation, "Expand extension work with wholesalers, retailers, and secondary suppliers to encourage better handling and merchandising methods."

Additional funds were provided for the expansion of this work in fiscal year 1955.

Work under this phase of the extension program includes educational programs on merchandising principles, practices, and problems for food wholesalers, retailers, and their secondary suppliers that provides the stimulation and information from which practical results of competitive efficiency and expanded markets for food products can be realized.

In the retail distribution field there are approximately half a million food stores employing about $1\frac{1}{2}$ million people. The majority of these outlets are independently managed business operations that realize 62 percent of the total food sales. It is mostly with this group that adult educational programs can contribute continuing needed assistance in the areas of business management, personnel training, and overall merchandising efficiencies.

The corporate chains, while considerably less in number and total sales volume, can utilize the services of public educational agencies such as Extension, particularly with youth activities and market information.

While the program objective has been one of personal and immediate advantage to the market operator, reported results of this work indicate that growers and consumers receive benefits also. These results include adjustments in operating and merchandising methods and practices that have served to increase efficiency, lower merchandising costs, reduce spoilage losses, and increase sales. One county, for example, reports the expansion of community markets for graded packers and quality controlled fruits and produce, from local production alone, because of this newer educational activity.

During the past year, educational programs in food merchandising activities included some 16 States and 2 territories. Through the typical program of demonstrations incorporated into informational meetings, longer term educational clinics and commodity merchandising programs over 6 thousand local trade people were stimulated and helped to merchandise profitably more fresh fruits and vegetables, as well as other perishable foods during the past year.

Plans - With funds presently available, work will be expanded and intensified with retailers, wholesalers, and secondary suppliers to encourage better merchandising and handling methods, practices, and techniques.

- B. Proposal for Committee Consideration - Expand educational work with wholesalers, retailers, and secondary suppliers to encourage better merchandising and handling methods, practices, and techniques.

Work on Produce Market
Facilities

Progress and Findings - 1954 Recommendation, "Expand extension work on produce market facilities (assembly markets, concentration markets, secondary and terminal markets) and initiate extension work on materials handling, equipment and work methods with growers and handlers."

Additional funds were provided for the expansion of this work in fiscal year 1955.

In many States during the past year, State extension marketing specialists and county agents have been requested to conduct educational work on improving marketing facilities. Since there is a rapid change in the producing areas for different fruits and vegetables, the need for new and additional facilities in some areas and the need for converting old facilities in other areas is acute. For example, in Massachusetts the extension marketing specialist has been requested to carry on educational work in the Connecticut valley, as well as follow-up work on the whole-sale produce market in Boston. In Pennsylvania, educational programs with farmers' markets assumed a place of importance. Farmers' markets constitute an important outlet for locally grown produce in many States and work with these markets has taken several forms. For example, after several years of educational work during which market improvements were talked about and various meetings held, the Scranton market authorities finally decided to erect shelters overhead for the convenience of both buyer and seller. Marketing and agricultural engineering specialists worked in preparing specifications for several types of shelter. The extension marketing specialist met with the directors of the organization and advised them on what was being done in other States along direct marketing lines. In Michigan, the extension marketing specialist met with the Michigan Market Managers' Association and kept them advised as to the trends in marketing facilities and various practices and methods .

Much of the extension marketing specialist's time is devoted to educational programs with county agricultural agents and other public workers in order to assist them with their local programs. The new farmers' market built in Lucedale, George County, Mississippi, 1952 as a result of Extension AMA marketing work has continued to grow this past year. The county agent and the extension marketing specialist have continued to work with the leaders and growers around the area of this market. The value of commodities marketed through the Lucedale marketing facilities increased substantially during this past year. For example, 5 thousand acres of watermelons, 3 thousand acres crowder peas, butter beans, sweet peppers, and other vegetables and fruits were marketed through these facilities in 1953.

Plans - Increase emphasis in this work during the coming year as increased funds will permit.

- C. Proposal for Committee Consideration - Expand and intensify educational work to improve produce marketing facilities, operations, and methods with growers and handlers.

Educational Work With Consumers

Progress and Findings - 1954 Recommendation, "Expand extension program in consumer education." Additional funds were provided for expansion.

Marketing information programs for consumers encourage more effective utilization of farm products. These programs benefit the consumers or customers who purchase food and also the merchants and farmers who are marketing these products.

Consumer education work in 28 States now cooperating in special programs covers several of the large population centers but reaches only about 10 percent of our people. Radio, television, and newspapers are the usual means of presenting this information to the public. Food editors, health and welfare workers, schools, and public institutions also use this food marketing information.

Consideration is given to the following types of information:

1. Seasonally abundant supplies of food, marketing peaks, and shipment and price comparisons.
2. Selection of food, grades, quality, variety, new uses, and food preparation.
3. Marketing research, nutrition, and other information about food.

Satisfied customers will be better customers and will buy more of specific foods in season. It is the objective of this program to help consumers understand the food situation and to know the food they buy so they will be good customers. Favorable reports from consumers, merchants, and farmers indicate that this program has been helpful, but it needs to be expanded so as to reach more people.

Plans - Expand the program this year in line with additional funds that have been made available.

- D. Proposal for Committee Consideration - Expand educational program with consumers to include additional areas such as Chicago, Cincinnati, Memphis, Portland, and New Orleans.

Proposal for Committee Consideration.

- E. Initiate educational work on materials handling equipment and work methods with growers, shippers and handlers.

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